THE NATURAL GAS OPTION—NEW RESOURCES AND NEW TECHNOLOGIES

HEARING

BEFORE THE

SUBCOMMITTEE ON
ENERGY DEVELOPMENT AND APPLICATIONS

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

NINETY-SEVENTH CONGRESS

SECOND SESSION

JULY 30, 1982

[No. 133]

Printed for the use of the
Committee on Science and Technology

U.S. GOVERNMENT PRINTING OFFICE
99-979 O WASHINGTON : 1982

H701-101

COMMITTEE ON SCIENCE AND TECHNOLOGY

DON FUQUA, Florida, *Chairman*

ROBERT A. ROE, New Jersey
GEORGE E. BROWN, JR., California
JAMES H. SCHEUER, New York
RICHARD L. OTTINGER, New York
TOM HARKIN, Iowa
MARILYN LLOYD BOUQUARD, Tennessee
JAMES J. BLANCHARD, Michigan
TIMOTHY E. WIRTH, Colorado*
DOUG WALGREN, Pennsylvania
RONNIE G. FLIPPO, Alabama
DAN GLICKMAN, Kansas
ALBERT GORE, JR., Tennessee
ROBERT A. YOUNG, Missouri
RICHARD C. WHITE, Texas
HAROLD L. VOLKMER, Missouri
HOWARD WOLPE, Michigan
BILL NELSON, Florida
STANLEY N. LUNDINE, New York
ALLEN E. ERTEL, Pennsylvania
BOB SHAMANSKY, Ohio
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
MERVYN M. DYMALLY, California

LARRY WINN, JR., Kansas
BARRY M. GOLDWATER, JR., California
HAMILTON FISH, JR., New York
MANUEL LUJAN, JR., New Mexico
HAROLD C. HOLLENBECK, New Jersey
ROBERT S. WALKER, Pennsylvania
EDWIN B. FORSYTHE, New Jersey
WILLIAM CARNEY, New York
MARGARET M. HECKLER, Massachusetts
F. JAMES SENSENBRENNER, JR., Wisconsin
VIN WEBER, Minnesota
JUDD GREGG, New Hampshire
RAYMOND J. McGRATH, New York
JOE SKEEN, New Mexico
CLAUDINE SCHNEIDER, Rhode Island
JIM DUNN, Michigan
BILL LOWERY, California

HAROLD P. HANSON, *Executive Director*
ROBERT C. KETCHAM, *General Counsel*
REGINA A. DAVIS, *Administrator*
GERALD E. JENKS, *Minority Staff Director*

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS

DON FUQUA, Florida, *Chairman*

TOM HARKIN, Iowa
JAMES J. BLANCHARD, Michigan
RICHARD C. WHITE, Texas
HAROLD L. VOLKMER, Missouri
HOWARD WOLPE, Michigan
BILL NELSON, Florida
ALLEN E. ERTEL, Pennsylvania
DAVE McCURDY, Oklahoma
ROBERT A. ROE, New Jersey
RICHARD L. OTTINGER, New York
JAMES H. SCHEUER, New York
MARILYN LLOYD BOUQUARD, Tennessee
ROBERT A. YOUNG, Missouri

HAMILTON FISH, JR., New York
F. JAMES SENSENBRENNER, JR., Wisconsin
VIN WEBER, Minnesota
JUDD GREGG, New Hampshire
JOE SKEEN, New Mexico
CLAUDINE SCHNEIDER, Rhode Island
RAYMOND J. McGRATH, New York
JIM DUNN, Michigan
ROBERT S. WALKER, Pennsylvania

DR. MARTHA KREBS, *Subcommittee Staff Director*

---

*On assignment to Budget Committee for 97th Congress.

CONTENTS

WITNESSES

	Page
July 30, 1982:	
Lloyd Elkins, Tulsa, Okla.; Thomas Gold, professor of astronomy, Cornell University, Ithaca, N.Y.; and Robert Benner, director of technology, Sun Gas Division, Sun Exploration & Production Co., Dallas, Tex	5
Mike Slater, Yates Petroleum of Artesia, N. Mex.; David A. Northrop, Sandia National Laboratory of Albuquerque, N. Mex.; and A. M. Derrick, El Paso Natural Gas Co. of El Paso, Tex	47
AFTERNOON SESSION	
Charles Turpen, secretary, Department of Energy and Minerals, State of New Mexico; Dorothy Hellums, county commissioner, Chaves County, N. Mex.; Jerry Don Martin, rancher; Bill Armstrong, Jr.; and Peter Hanagan, executive vice president, New Mexico Oil & Gas Association	84

APPENDIXES

I. Statements for the record:	
a. George A. O'Connor, acting director New Mexico Water Resources Research Institute, New Mexico State University, Las Cruces, N. Mex	172
b. Henry B. Taliaferro, Jr., executive vice president the GHK Co., Oklahoma City, Okla	175
II. Additional material submitted for the record:	
Charles D. Turpen, secretary, Department Energy and Minerals, State of New Mexico, Santa Fe, N. Mex	185
III. Questions and answers for the record:	
Transwestern Gas Supply Co., Midland, Tex	226

THE NATURAL GAS OPTION—NEW RESOURCES AND NEW TECHNOLOGIES

FRIDAY, JULY 30, 1982.

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS,
Washington, D.C.

The subcommittee met, pursuant to call, at 9:10 a.m., in the Rio Grande Conference Room, Roswell Inn, N. Mex., Hon. Joe Skeen presiding.

Member present: Mr. Sensenbrenner.

Staff present: Dr. Martha Krebs, staff director; Lee Wallace, minority energy coordinator; Bob Lamina, Mr. Skeen's staff.

Mr. SKEEN. We are going to call this to order and get started as close to time as we can because we particularly appreciate the time that is being given us by the groups that have accepted the invitation to come and appear here today.

We want to utilize every minute to the best advantage and we will try to start early.

Let me do a little explaining before I get into the welcomes.

When this hearing was set up, we had, as we always do in Congress, a great deal of trouble knowing what the floor schedule of the House itself, was going to be, and whether it would accommodate itself to the kind of travel that we must do to bring a hearing of this kind out to Roswell.

This is an extremely important hearing to those of us who serve on the Science and Technology Committee and the Energy Development and Applications Subcommittee.

But the rules of the Congress are that in general, you ought to have a member of both the majority and minority parties to have a field hearing or committee hearing.

Congressman White of El Paso had accepted the chairmanship of this particular hearing, but he was caught in the dilemma yesterday of having to stay on the floor and vote for the Department of Defense budget authorization. We then ran into a little difficulty yesterday afternoon.

We had to leave by 5 p.m., Washington time, to catch an airplane that would get us here last night and then come down on Air Midwest into Roswell. We wanted all who are visiting here to appreciate what we have to do to travel by air to New Mexico.

We also wanted to help Albuquerque out with one night's lodging, just a few things like that. But since Congressman White is

the chairman of a subcommittee in the Armed Services Committee, he could not leave the floor in time to make that airplane.

Besides that, he came down with laryngitis. He was working an amendment dealing with the divorced-spouse portion of the retirement benefits for the military, which was an emotional battle. So he was operating under very difficult circumstances.

So he asked me to convey to you his apology for not being able to be here because of the problems of getting him down here. The rest of us missed two votes and we jealously guard that record of voting, because if you are in this great Congress, the first thing your next opponent is going to do is jump on your record.

Fortuntely, the rules of the House permit a hearing to go on as long as there are two members of either party. Since my good friend Jim Sensenbrenner has taken the trouble to be here, we will be able to hold the hearing, but with the unusual circumstance of myself chairing the hearing.

Let me stress once again how important it is that we have this testimony because this is the manner in which we inform the Congress of the United States how we produce energy resources, and what are the ramifications of what has already been done with the application of new technology in the area of gas recovery in the State of New Mexico which has added some 14 trillion cubic feet to the gas reserves of this country.

That is significant.

This testimony is significant and I want to say welcome to the witnesses, particularly, who have given us your time and are here today. We appreciate it very much.

I also want to thank the committee staff, minority and majority, that have worked on putting this together. That was another reason why I decided that I could forgo having two votes on the floor yesterday because of the work that has gone in, and because the acceptance has been so good. I want to mention that we have an outstanding staff on Science and Technology, Martha Krebs, who is here with us; Lee Wallace, who is also with us on the committee staff, and on my extreme left, Mr. Bob Lamina, of my legislative staff, who has been made an honorary New Mexican since he came from Pennsylvania.

I want to thank Jim Sensenbrenner, the Congressman from Wisconsin, who did as I did, to be here. He——

Mr. SENSENBRENNER. Played hooky.

Mr. SKEEN [continuing]. Played hooky, yes, but I want to thank you for taking the time to come out here because this is important information to be distributed to Congress. It tells our side of the story of energy production.

I would like to have you welcome and introduce to you Jim Sensenbrenner from Wisconsin. Let's give him a good New Mexican welcome.

Mr. SENSENBRENNER. Thank you very much, Joe.

I am certainly happy to be here in New Mexico today, even though my name tag says I am from Minnesota, which isn't the case. I won't say I am happy to be in Arizona because I know there is some confusion in our respective areas of the country on this.

Wisconsin is one of three States in the country that produces no energy whatsoever. Every ounce of energy that is consumed in my

State is imported from another State or from a foreign country, and that is why I think it is perhaps doubly important that those of us who represent people in energy-consuming States come and learn about new techniques of energy production. One of our jobs, as Representatives of our people, is to insure that the people who live up where it is getting plenty cold in the wintertime will have a sufficient amount of energy at a reasonable price to meet our needs for our schools, our homes, as well as for our industry, which produces our jobs.

I am hopeful that hearings like this can produce a greater understanding, because there has been quite a bit of demagoguery that we hear in the Halls of Congress against the oil- and gas-producing industry, and a lot of proposals in Congress surface which really serve no one well, producers, consumers, and those who are in between.

Joe Skeen has told me about some of the successes in the Roswell area on natural gas. I think that this is something about which the Congress needs to have more knowledge so that when we on the Science and Technology Committee allocate our research and development dollars, we can allocate those dollars as wisely as is possible to insure that the American taxpayer will get the biggest return on the dollar that the Congress of the United States can possibly give.

So, again, it is good being here in Roswell, N. Mex., today, and I certainly appreciate Joe Skeen inviting me to come and join you this morning.

Mr. SKEEN. Thank you very much, Jim, we appreciate having you here.

I will give a short explanation of what we are about to do and we will get this on the road.

We have three excellent panels of witnesses with us today to discuss "The Natural Gas Option—New Resources and New Technologies."

That is the subject and the total focus of this hearing today.

The first two panels will consist of experts in their fields, who will discuss unconventional and traditional resources of natural gas, the technological needs of the industry to develop these resources, and the impact of price fluctuations on their production plans and on the future growth of the natural gas industry.

The third panel is somewhat unique for this committee, because it will consist of concerned citizens to discuss the advantages and disadvantages of accelerated natural gas and oil production on host States and local communities.

That is an important aspect of this hearing, that is the question you get in Congress, what is the impact of this activity, is it acceptable or not?

As citizens of New Mexico, we are very interested in these hearings because we rank fourth nationally in gas reserves and production.

There are almost 14 trillion cubic feet in proven gas reserves and an additional 6.5 trillion cubic feet in probable reserves.

However, there is no doubt that much of the future gas production from the West will come from areas designated as tight gas

sands, such as the Permian Abo formation, which was so designated by FERC last summer.

That is the Federal Energy Regulatory Commission. I always give you the acronyms because this is the only way you can learn to be a real Congress person, you must know what HUD means, FERC, FEMA, and all the rest.

That is the language that they get into. No wonder we are not understood well.

Such recognition brings more realistic pricing to gas produced from this area. Instead of receiving only $2.81 per Mcf under section 102 of the Natural Gas Policy Act, the gas is eligible to receive almost $5 per Mcf under section 107 of the act.

There is no doubt that this increased price is well-deserved because of the greatly increased cost for production; a single, experimental well by Yates Petroleum, cost-shared with the New Mexico Energy Research and Development Institute, cost more than $200,000.

However, the experiment was able to nearly triple production from the gas well in Eddy County.

Such results from experimental production in tight sands have applications throughout the West. Estimates of the tight gas resource trapped in both the lenticular and blanket formations range from 300 to 1,000 Tcf. While 0.3 Tcf per year is currently being produced from tight gas sands, substantial new production is dependent on the development of advanced technology.

Almost 90 percent of the resource base is in lenticular formations which cannot be produced with current technology. Production estimates in the year 2000, given only existing technology, will probably be less than 3 Tcf per year, while development of advanced technology could increase production to approximately 6 Tcf per year.

We hope that these hearings will point out areas in technology which can be developed, in addition to providing the Congress with a better understanding of the natural gas industry itself, and its potential for development.

We will like to start with the first panel this morning.

Mr. SENSENBRENNER. Mr. Chairman, I would just like to request all of the witnesses who appear before the subcommittee today to summarize their testimony in 5 to 10 minutes' time rather than reading statements that have been filed with us.

I don't think we will get to very many questions if the statements are read, so if you would summarize, please, we will have time for questions and elucidation.

Mr. SKEEN. We don't want to cut anyone off, and your statement is a pertinent part of the testimony.

Dr. Thomas Gold, professor of astronomy at Cornell University is with us; as is Robert Benner, director of technology, SunGas Division, and Mr. Lloyd Elkins from Tulsa, Okla.

STATEMENT OF LLOYD ELKINS, TULSA, OKLA.; THOMAS GOLD, PROFESSOR OF ASTRONOMY, CORNELL UNIVERSITY, ITHACA, N.Y.; AND ROBERT BENNER, DIRECTOR OF TECHNOLOGY, SUN GAS DIVISION, SUN EXPLORATION AND PRODUCTION CO., DALLAS, TEX.

Mr. GOLD. Mr. Chairman, members of the committee, I am very happy to be here and have the opportunity to tell you about our research which puts a much more favorable picture for gas than is generally believed.

I and my group at Cornell have worked for more than 5 years entirely on the subject of origin and distribution of natural gas on the Earth. We have come up with a viewpoint which is substantially different from the one that had been the current one for a long period of time.

We base ourselves on a great deal more information and knowledge that we now have of the the origin of the solar system, the early processes that put together the Earth, the findings both of the Planetary Research of NASA, the findings of meteorite research in recent times; and I have to tell you that one should not take too seriously the conclusions that were reached 50 years ago about this subject.

We know a great deal more now and we should not just perpetuate the viewpoint of long ago.

Our conclusion is based on strong evidence; it is that a large proportion of the excess carbon which we know the surface of the Earth to contain, carbon that does not come from erosion of rocks, a great proportion of that appears to have come from deep below in the form of methane, CH_4.

It used to be believed that outgassing had taken place but that it was in the form of CO_2, carbon dioxide, which would be much less interesting for us, of course.

We are now quite convinced that a substantial proportion outgases as CH_4. The quantities of gas that have come to the surface and brought the carbon up are, of course, absolutely immense compared with the quantities of natural gas that you discuss in the conventional type of deposits.

So an understanding of this process makes a profound difference to the estimates of the amounts of gas, methane, that are on the way up, reaching the surface from deep below.

If, as had been generally believed, any methane that you find is only the consequence of plant debris that had been pushed underground, then the quantities that you would find at the deeper levels would be quite limited, and it is on this consideration that the prediction was based that we would soon run out of natural gas.

On the basis that methane comes from below, the lower levels that are reachable, but deep, will be very likely filled with gas. It would be unlikely for them to be well-filled if they were supplied from above, but very possible if supplied from below.

It is my view that the deeper levels between 15,000 and 30,000 feet will contain not just a few times more than people have previously thought, but a matter of 100 times more.

Deep drilling is in my view the answer to our energy problems for many years to come and everything should be done, therefore, to encourage the deep drilling.

Now, I don't have to go into the details of the evidence we have for this viewpoint, but let me just quickly say that it comes from large-scale relationships of trace elements in the hydrocarbon deposits, ocean rifts that give out hydrocarbons, the continental rifts, all make abundantly clear that hydrocarbon gases come from very deep formations.

Now, why don't we know about the amount of deep gas that we have? The trouble is that deep drilling is expensive, and the real way of knowing is only by the drill. One can do a great deal to prospect by other means, but in the end, deep drilling is required.

Since it is expensive, one can never hope to obtain meaningful estimates of the amount of deep gas that there is to be had unless the market exists for selling that gas at the kind of price that deep drilling entails.

Deep gas is never going to be cheap, but it is perfectly capable of being competitive with imported oil. If the market existed in which it would compete with imported oil, if power stations used it, and if it could go to all the uses to which oil is now put, it would in many cases be preferable because this methane is cleaner, and it could be produced domestically.

But we should never pretend that the information we have about the reserves underground has any meaning at all unless the market has opened it up.

One would always only be a small step ahead of the usage in this case, because nobody is going to explore the deep horizons unless he has a reasonable chance of recouping his expenses.

Now, we have moved into a difficult situation, which I regret very much, because I feel so strongly that the whole fuel crisis can be eradicated completely. We must make sure that the deep gas is allowed to compete with imported oil and not forced to compete in a restricted market with the remaining shallow gas that still exists. The shallow gas will not solve the energy problems, but it would be enough to ruin deep drilling for quite a few years and then put us back into the situation where in a few years' time, the shallow gas has run out and we would have to crank up a deep-drilling program again.

Burning methane is enormously better for the environment than any other fuel. It is less destructive to the environment to produce it than any other fuel, and it is cleaner burning.

If one is worried about the CO_2 load that the atmosphere acquires, methane produces only half as much CO_2 for a given amount of energy as coal, and somewhat less than oil does.

In the long run, if one is really worried about the carbon dioxide load, then methane would give you the possibility of extracting from it just the hydrogen, which can be done by quite a straightforward process, and using the carbon for other industrial purposes, but not for burning.

In that case, you would have a completely clean fuel, hydrogen, in which you produce as the byproduct only water and nothing else. Only half the energy is the used, but if methane is as plentiful as I think, this might be acceptable.

Now, regarding the research that can be done in this field, you have in New Mexico an excellent laboratory, the Los Alamos Scientific Laboratory, which could undertake a great deal of trace element work for which they are extremely well set up which I believe will facilitate the search for deep gas very greatly and enormously improve the probability of finding it where you have placed your expensive drill hole.

The Sandia Corp., in New Mexico is experimenting with better drilling machinery and I have no doubt that it would also be a very major thing if deep drilling can be made cheaper. I am convinced it can be done, because deep drilling is still in its infancy at the moment.

It can probably be brought down to half the cost in real dollars, and the deep gas would then become substantially cheaper. If you produce it in an open, free market, without Fuel Use Act restriction, it would help to depress or keep level at least the price of oil in the world.

The United States is the world leader in deep drilling. Nowhere else is so much done. Yet, even here, it is only a few percent of the deep horizons that might contain gas that have been touched.

I feel that that leadership should really be utilized in this country to drill, accelerate deep drilling and arrange for the pricing of gas in such a way as to make it interesting to continue vigorously with deep drilling, because that is the way to get out of the energy squeeze.

For the rest of the world, also, I would hope that the deep drilling expertise in this country could be made available to some of the other energy-hungry countries in the world. I would feel that showing the energy-hungry countries the technology for finding their own gas would serve the United States a lot better than trying to deny them the technology for importing it, which is what we are trying to do at the moment.

All the other countries in the world that need energy have a good chance of finding the deep gas, also. They have hardly attempted to look for it, because the knowledge has not been there that it is worth doing.

[The prepared statement and biographical sketch of Mr. Gold follows:]

Testimony by Professor Thomas Gold
before the
Committee on Science and Technology
Subcommittee on Energy Development and Applications
U.S. House of Representatives

July 30, 1982
Roswell, New Mexico

* * * * * * * * * * * * * * * * *

Mr. Chairman, members of the Subcommittee:

I see the subject from the perspective not of a genuine global shortage of energy sources, but of a shortage which is purely man-made and therefore can be removed completely by appropriate action.

I and my group at Cornell have worked for five years now on the subject of natural gas, its origin and the chemical and biological processes through which it is related to other hydrocarbon deposits. This work brings us to the conclusion that natural gas is enormously more prevalent than has hitherto been thought. In particular the deeper range of the accessible levels, from 15,000 to 30,000 ft depth, is likely to contain reserves that are very much greater than all known shallower reserves of oil and gas. This holds for the territory of the U.S., but also for a large fraction of the rest of the world. If this is correct then the policy that can make the U.S. independent of imported oil is a policy that encourages an exploration and drilling program to these depths. I will return to this point later, but first I should make clear what the scientific reasoning is on which we base our optimistic outlook concerning gas.

In recent years one has come to understand a great deal more about the construction of the solar system, in part through the

space science programs of NASA, in part through meteorite research, and in part through general advances in physics and chemistry. Through this one gains new insight into the construction of the planets, including the Earth.

The element carbon, the fourth most abundant in the solar system, is very prominent among the major planets and their satellites, among the comets and the asteroids and also among the meteorites that fall on the Earth. The greatest quantity is, of course, in the major planets and there it seems to be mostly in the form of methane gas (CH_4) while it is in the form of solid hydrocarbons and other unoxidized carbon compounds in the carbon-rich meteorites called carbonaceous chondrites. In the chemical evolution of the solar system, most of the carbon was turned into hydrocarbons.

The rocks that compose the bulk of the Earth have only very little carbon in them, yet the surface and the sediments contain much carbon, and it is clear that there was a large extra supply, not just the weathering of the rocks that made up the sediments. Like the water of the oceans and the nitrogen of the atmosphere, carbon must have been supplied from buried materials and migrated to the surface as a gas. Substantial accumulations of materials like that of the carbonaceous chondrites appear to have been included in the forming earth and later, under the action of heat and pressure, they have evolved gases that escaped to the surface. Carbon, in that case, would be expected to be predominantly in the form of methane at the outset.

That an outgassing process of the Earth from some particular layers or pockets underneath must be responsible for most of the volatile substances on the surface, has been appreciated for some time. It used to be thought however, that the carbon was supplied entirely in the form of carbon dioxide (CO_2) and that, in any case, methane, the other possible carbon gas, would not be stable at depth. The new realization is that methane is a much more likely source of the carbon and one has clear evidence that methane does exist at depths of more than 100 kilometers (60 miles). It has also become clear that methane will be stable on some of the pathways leading to the surface. These realizations have come about as a result of a better understanding of the chemical circumstances in the deeper layers of the crust of the Earth, a study of the processes by which gases can make their way to the surface and the recognition of many clear indications of a deep origin of natural gas deposits. In some circumstances the methane will be burnt on the way up and the resulting CO_2 that is created has been responsible in the past for the opinion that CO_2 was the only carbon gas emitted from the deep Earth.

The situation is well summed up in the recent report of the Gas Research Institute (GRI 1981 Annual Report), from where we take the following quote:

> Theory of non-biological origin of natural gas stimulates increasing interest and acceptance. Present gas exploration practices assume that natural gas and other hydrocarbon deposits were produced solely by the decomposition of plant and animal remains from previous eras. This assumption is now under strong challenge by a theory in which the role of organic materials may be only supplementary to preexisting methane of non-biological,

or abiogenic, origin. Broader acceptance of the theory, resulting from a growth of supporting evidence, could lead to radical changes in deep gas exploration strategies and subject to proof of economic viability, the discovery of a much larger resource base than is now thought to exist.

Being explored by Professor Thomas Gold of Cornell University with GRI support, the theory of abiogenic methane combines the findings of research in astrophysics with evidence from several natural phenomena on Earth. The theory postulates that vast quantities of hydrocarbon gases existing at the earliest stages of the Earth's history became trapped deep below the planet's surface. Slowly migrating upward over eons of time, some abiogenic gas may have reached reservoirs with impermeable caps; some combined with oxygen, escaped through volcanoes as carbon dioxide, and combined with calcium in the oceans to form carbonate rocks; some interacted with organic hydrocarbon deposits, enlarging and enriching them; and some escaped through deep faults directly into the oceans and atmosphere as free or dissolved methane.

A number of scientific observations forms a growing body of evidence in support of the abiogenic methane theory.

High success rates in deep drilling for natural gas have been noted in several areas, and indeed a very widespread presence of gas at the deeper levels has been noted, as could be expected on the basis of the theory outlined above, but was not expected on the basis of a purely biogenic origin. Some of the drillers are convinced now that the quantities of gas that they have found could not be explained otherwise. Others, who still side with the biogenic theory of the origin of the gas, believe then that the circumstances for the deposition of the source material at great depth must have been very much more favorable than had previously been thought. In any case there is very widespread agreement among those who have probed the deeper horizons that gas is extremely plentiful there.

At shallow levels gas in commercial quantities can only be found where there is an exceptionally good caprock. This is true whatever the origin of the gas may be. At the deeper levels the rock tends to be compressed by the weight of the overburden, and this causes underlying gas-filled regions to be sealed off without the requirement of a particularly impervious material. The underlying gas is then at a pressure at which the pores or fractures in the rock can be held open. If the gases generally come from below then this deep domain is likely to be frequently filled with gas and the amounts that could be expected in the depth interval from 15,000 to 30,000 feet in the United States may then be hundreds of times more than had previously been estimated.

There has been much more deep drilling in the United States than elsewhere in the world. Indeed hundreds of gas wells have been drilled in this country to depths of 15,000 feet or deeper and a good many are producing. U.S. drillers are the undoubted world leaders in this technology. Their skill and experience could help greatly to explore the deeper levels in Europe or in Japan where the finding of large quantities of deep gas would have the greatest impact.

Despite the leading position of the U.S. in this field it is still only a very small fraction of the potentially gas bearing rocks in the U.S. that have been explored by the drill. It has been estimated that 97% of possible gas reservoirs remain to be investigated.

Much could be done to improve the scientific and technical base on which prospecting techniques have to rely, and a program of research and development in this area would be of the greatest benefit. In the preparation for shallow drilling very sophisticated investigations might not have been economically viable. The high cost of deep drilling should produce quite a different outlook there. Seismic exploration has been greatly improved and is in full use. Other possible exploration techniques are still largely neglected, but could make a very substantial difference in defining more closely the areas in which the large investment of deep drilling is worthwhile.

Several surface chemical associations with deep gas reservoirs have been noted, such as the presence of particular trace elements above gas fields as well as the presence of unusual carbonates in the surface soil. In many cases the relationship of these surface characteristics to the underlying deposits could not be doubted, but nevertheless with too little understanding of the reasons for these relationships, the techniques were not trusted sufficiently to find a wide application for prospecting. On the basis of the outgassing theory which I have outlined, it becomes clear that most gas bearing regions have been greatly oversupplied, and that the amounts caught in the traps are very small compared with the amounts that have leaked out. Chemical prospecting can find the termination of the leakage paths on the surface and therefore give a set of new clues as to the position of the traps. Surveys of a range of trace elements over known gas deposits should be carried out on a large scale so as to learn more

99-979 O - 82 - 2

of the associations to be expected. Scientific tools for trace element analysis in the field should be devised, so as to make rapid surveys of big areas of land a practical possibility. Modern methods of chemistry are extremely powerful, and have not yet been applied to a search in the field. The cost of finding deep gas could be greatly reduced by the introduction of such techniques, and this would of course show in the ultimate price at which the deep gas could be produced.

The Los Alamos Scientific Laboratory would be very well placed to undertake such work. It has superb facilities that are very well suited to such tasks as trace element analysis, and of course the region would be ideal for experimentation in the field. It would be worth while to have a major program in this area, considering the economic importance of it. The laboratory could have a great impact on the entire field of prospecting for hydrocarbons.

But even with a great improvement in the methods of prospecting, a vigorous deep drilling program will still be required to discover the large reserves of deep gas. Also here a federal program can be of help; but it is most important that the industry should have the incentive and the financial resources to enter into a large deep-drilling program. This brings me to the problems of policy and of economics. The high cost of deep drilling means that no cheap gas can be produced from the deep levels. It can however, be produced at a price that is competitive with that of imported oil for many applications. A drilling program can be sustained only if an expanding market at an adequate price level can be assured. Without such a drilling program, the large reserves of

deep gas may be suspected but they cannot be discovered. Drilling is still the only way of making the discoveries and the large capital resources necessary for this will not become available unless there is a reasonable assurance of such a market.

If the deep drilling industry can expand, it seems not unreasonable to expect that the real cost of production of deep gas could be brought down substantially through improvements in tools, materials and techniques. A reduction of deep drilling costs to half of what they are now would seem possible within three or four years. An important line of development work for deep drilling is in progress at the Sandia Corporation in New Mexico.

The curb on the expansion of the gas market stems from the belief that the gas resources are small and in turn, the large resources which we believe to be there, cannot be discovered except when a greatly expanded market is available. Before the discovery of deep gas and the realization that it is a very large resource, it was thought that the domestic gas supply would soon dwindle and therefore it seemed prudent to limit the market. New industrial use was prevented by the Fuel Use Act, as was the use of gas in electric power generation. This prevented the expansion of the market, and meant that the remaining shallow gas, that could be produced much more cheaply, could satisfy this limited market almost completely for the present.

Due to the limitation of the market, exploratory drilling to the deep levels was much more limited than it could otherwise have been, and therefore the rate of certified new discoveries was regarded as disappointing. A low rate of new discoveries was taken by some to mean that the restrictions on the use of gas should be retained. This policy leads to a downward spiral and

to a continued dependence on imported oil, even if gigantic resources of deep gas exist in the country, that could be produced at a price competitive with the imported oil. The prediction of a shortage leads to regulations that create a real shortage. Similarly the understanding that there is a large resource base should lead to a regulatory policy that allows this resource to be opened up. Most Americans would prefer to see the money spent here to find and produce domestic gas than to spend it abroad for the continued importation of oil. A vigorous pursuit of this resource should lead to complete energy sufficiency in just a few years.

Energy independence is obviously desirable from many points of view, and in the economic picture one may wish to include the large savings in military expenditures that would then be possible. It could be argued that even at a somewhat higher cost than that of the continued importation of oil, it would be worth it. This has indeed been the outlook which was responsible for the Synfuel programs, which we consider would be far less productive for the same investment and far more damaging to the environment than a rapid exploration and exploitation of the deep gas resources.

A program to create energy self-sufficiency in a few years, based on the deep gas resources, would have to allow the deep gas to replace imported oil in all applications where it can be competitive. A changeover from oil to gas in most stationary applications can be achieved quickly and at modest cost. The problem of sulfur and other effluents is greatly diminished, and gas-burning on an industrial scale can comply with stringent clean air regulations. One can see many advantages and no disadvantages in allowing the deep gas resource to be opened up by giving it the free market in competition with imported oil.

If, however, the market remains constricted and the deep gas has to compete for this limited market with the remaining shallow gas which is much cheaper to produce, then for the present further deep exploration would be stopped. The supplies of shallow gas will indeed dwindle in the course of a very few years, and a new fuel crisis, high fuel prices and an increased dependence on foreign oil would be the consequence. It is true that there would then be an incentive to drill the deeper levels again, but a number of years will have been lost and the consequences of an increased dependence on imported oil will have been felt.

From the environmental point of view a move from all other fuels to gas is very desirable. The content of sulfur and of other damaging substances in the effluent can be kept very much lower without incurring economically unacceptable costs. Drilling for gas produces a minimal disturbance to the landscape, incomparably less than mining coal or any of the attempts to extract energy from oil shales or tar sands. Deaths from accidents or disease are at a far lower level for gas drilling than for any mining operation.

It is not certain yet that the build-up of atmospheric carbon dioxide is creating a problem, but one should be prudent. The burning of natural gas produces only about half as much carbon dioxide for the same energy released as the burning of coal, and also substantially less than the burning of oil. There is a clear case that gas is the most desirable of all fuels and that therefore the greatest effort should be made to expand its use as rapidly as possible.

Further in the future, but probably still several decades away will come the time that horizons well below 30000 feet will need to be tapped. By then it is probable that new materials and new drilling techniques will be available, and so, for a long time, the energy resource of deep gas will be able to keep up with the demand. As we have said, the atmospheric carbon dioxide burden will be minimized by reliance on gas compared with the combustion of any other fuel, but if the carbon dioxide poses a real problem nevertheless, one could go one step further. If methane becomes really plentiful, then one could afford to burn only the hydrogen component and leave the carbon, or perhaps find large scale industrial applications for it. In that case one would derive approximately half the energy but with the production of virtually only water vapor and no harmful effluents.

To sum up, it is my belief that we have a gigantic resource of natural gas in levels that are deep but accessible by present day techniques. It is of the utmost importance to make our country energy independent, and this resource is the quickest, most practical and least disturbing way of doing it. Regulatory policy must therefore be so shaped as to maximize the speed of development of this resource, and this will happen if every energy user is given the straightforward choice between buying deep gas or imported oil. Price regulations and market limitations of the past have created a difficult situation at the moment and it will be necessary to assure a substantial expansion of the market for gas before a competition between shallow and deep gas should be allowed to occur; otherwise the deep gas

would be temporarily at such a disadvantage that the development of the deep gas resource would be arrested. A real crisis would then develop in a few years when the shallow gas does run out. It would also mean a further delay before we can demonstrate that we can achieve energy independence, and surely such a demonstration is most desirable and urgent.

A major program to improve the science and technology of exploration for deep gas is desirable. Improvements in the technology of deep drilling are also a major concern, and should be considered of national importance, since these would shorten the time for the U.S. to achieve energy independence.

Biographical Sketch, T. Gold

Professor Thomas Gold is the John L. Wetherill Professor of Astronomy at Cornell University, and was the founder and for twenty years the Director of the Cornell Center for Radiophysics and Space Research. He is a member of the National Academy of Sciences (U.S.), of the Royal Society (London), the American Academy of Arts and Sciences, the American Philosophical Society, and of numerous other learned societies.

Before coming to Cornell in 1959, he was Professor of Astronomy at Harvard University, and before that Chief Assistant to the (British) Astronomer Royal. He is of Austrian origin, educated in Switzerland and in England at Cambridge University, where he received his B.A. (in 1942) and later the degree of Doctor of Science. He worked on the development of naval radar for the British Admiralty during world war II. He is now a citizen of the U.S.

His scientific publications are in many fields of science, and number more than 200. He is perhaps best known for researches in cosmology (the theory of the steady-state universe), for his explanation, now generally accepted, of the nature of pulsars as rotating neutron stars, and for many aspects of solar system research; among them was the correct prediction that a fine rock-powder would be the principal material that the astronauts would encounter on the surface of the Moon.

Professor Gold was a member of the Space Science Panel of the President's Science Advisory Committee for seven years. He was also a member of several NASA planning committees including

the Lunar and Planetary Missions Board. He has testified on several occasions before congressional committees, notably in opposition to the development of the shuttle, an opposition based on inherent shortcomings and high costs, all now borne out.

In recent years he has worked on the problems of the development of the volatile substances on the Earth, and has concluded that methane (natural gas) is available in very large amounts at deep but accessible levels.

Mr. SKEEN. Thank you very much.

If it is all right, we can just go through the other witnesses and then we will come back for questions.

Mr. Elkins.

Mr. ELKINS. Thank you, Congressman Skeen.

My remarks are titled "The Character of Western Tight Gas Sands and Major Technical Barriers to Development." To those of you who may not be familiar with gas technology, these tight gas rocks are one-thousandth the permeability we are used to dealing with in conventional gas sands.

We used to call it tombstone and we never even measured it this low until we realized the tremendous amount of gas in place, particularly in the Western part of the United States.

In my prepared remarks, I cover 7 Western basins in the West and there are 270 trillion cubic feet of gas resource. Somewhere between 60 to 80 percent of that gas can be recovered with the technology that is beginning to be developed in order to get this gas.

Now, you can't just drill a well down into this rock like the Mesa Verde formations that are all over the West here. And you can't perforate it and get much gas out of it.

You have to create a hydraulic fracture. Now, the hydraulic fracture is a fracture where you part the rock by fluid pressure and prop it open with sand or some other thing.

The type we are talking about for the western tight gas sands may be 200 to 400 feet high and 1,000 to 4,000 feet long on each side of the well bore. That is a long way. That goes across a square mile if it is 8,000 feet.

You don't have to do that in all cases, but that is one of the advanced technologies we are getting to.

Now, the reasons these fractures are important is that this gas, in order to get to a pressure sink takes a long time because it is extremely tight.

If you drill a hole, it is all radical flow and it converges on it and you won't get any gas that amounts to anything.

If you have this fracture open to a well, which it is, then you have a tremendous pressure sink, an area and gas over 30 years only has to flow in tight rocks maybe 200 or 300 feet to get to that

well and at the same time, have 320 acres of areas exposed to that fracture.

So fracturing is the name of the game. The big problem is, as the Honorable Mr. Skeen has mentioned, we have two types of gas deposits, one is a blanket, it spreads out over a whole township lots of times.

Then we have lenticular sands, and they are like river sand deposits, maybe 300 or 400 feet wide, 20 feet thick, maybe 5,000 or 6,000 feet long, shorter or longer, just like in any river bottom, sand is being deposited.

The fracture serves a dual purpose for both blanket and the lenticular sands and the blanket sands—these are really tight now—it provides this short flow path.

But you have to have a flow path, if you develop a section, you may need four or six wells and the area drained is shaped like a cigar rather than like a circle and so you have to lay these cigars out side-by-side in order to get the gas produced.

In the lenticular sands, it has the same kind of a drainage but the key to opening this up is that the fracture is created in a well in one type of sand, and you see it there and create the fracture and it goes out of that sand into other sands you can't even see at the well site.

If you don't expose a lot of sand that you don't see at the well bore, you will never develop lenticular sands at an economic rate and get anything like 60 percent of the gas in place recovered.

The Department of Energy has a multiwell experiment up in Colorado. When proven out, it will apply to all tight gas sands wherever they are for trying to find out what it takes to create this fracture and control its height and make it go where you want it to go, that is the point of it, in the sense of how far out it goes and whether it will stay in the 200- or 400-foot height.

Until that objective is achieved, we demonstrate that we can do it and have the technology to know how to control it, a lot of these tight gas sands will just sit here and just wait just like some of the deeper gas that you have just heard about.

One of the key things in this—it is in my prepared statement—is when this well is brought on production, it usually should be—on-capacity or near-capacity production for 30 years, it should last that long.

Something like 15 percent of its ultimate recovery will be produced the first year in a blanket sand and 18 to 20 percent is going to be produced in the first year in a lenticular deposit.

Now, that is important to the transporation people, and to an outfit trying to develop and drill these wells.

You know that if you got a market for 100 million cubic feet in a basin here, you have to get the wells drilled to start that off with and then every year, you are going to have to have a continuous development program to offset the decline that will take place on the first wells drilled.

So it is not one of these things where you jump in and drill 1,000 wells in a hurry, you get a number of wells started and then you can just systematically drill new wells and keep 100 million cubic feet supplied for years to come.

So it is recognizing those factors that are really characteristic of the tight gas sands that are really important.

I am convinced that we have the technology to create fractures 2,000 or 3,000 feet long. The only thing, we don't know how to control them.

We have to know the geology of the section, of course, to know whether we can expect this fracture to go out of one sand, through a shale section, and into another sand.

There is no way in God's world that you can get at this without going into the field and doing the work that is being done on the multiwell experiment up in Colorado right now.

If the Congress approves the budget that will let that program go on and even at a higher level of expenditure, over the next 5 or 10 years, we could crack this open and know what we can do.

But until that is done, we don't have a chance.

[The prepared statement of Mr. Elkins follows:]

THE CHARACTER OF WESTERN TIGHT GAS SANDS AND MAJOR TECHNICAL BARRIERS TO DEVELOPMENT

The thrust of this statement is embodied in the six tables included.

The estimated volume of the Resource (Gas in place) is shown for seven major basins in the Rocky Mountain States. See Table 1.

Perhaps 60 to 80 % of this is potentially recoverable. Most of this resource is in the permeability range of .03 to .0003 millidarcies (30 to .3 microdarcies) See Table 2.

The resource in these basins is approximately one half lenticular and one half blanket insofar as well drainage effectiveness is concerned.

Fracture length as a function of permeability largely controls the number of wells required to drain the technically recoverable gas. For blanket sands two cases are shown. See Table 3. Case B for a 1000' (1/2 length) and Case A for 4000' fractures. The beneficial effect of fracture length increases with declining permeability.

Fracture length in lenticular sands is principally directed to exposing sand lenses not exposed to the well bore. The "A" case 4000' fractures increases the recovery over "B" case 1000' fractures by virtue of contacting sands not otherwise subject to drainage. See Table 4.

Wells completed in tight gas sands have a typical productivity decline character. In Table 5 these are shown for a wide middle spread of the permeability range. The extreme high $>$ .1 md and low $<$ .001 md would be different in degree but not in shape. This character is important in scheduling development to meet stable market requirments. Also, if wells make water there is risk of creating a temporary, but painfully long, period of waterblocking if wells are alternately shut in.

Table 6 displays an approximation of fracture length needed to effectively drain blanket tight sands having different permeability devels.

What are the major technical barriers to full scale development? For blanket sands, fracture geometry needs to be controlled to get 1000' to 4000' penetration between overlying and underlying barriers. Insitu fracturability has to be known for the pay sand and barriers before fracture treatments can be designed.

For lenticular sands the fracture must penetrate alternating sand and shale lenses if this type reservoir is to be most effectively exploited. Fracture height must also be geometrically limited.

For both of these objectives insitu rock stress values need to be measured in various portions of the several basins and over the formation intervals going to be subjected to fracture treatment.

Matching fracture design treatments to rock stresses followed by field tests and post analysis of facture geometry are essential.

When increasingly long fractures are needed, knowledge as to fracture azimuth becomes essential. This can be determined while key test wells are fractured. Some supporting research will need to parallel these complex, time consuming, and expensive field tests.

The above types of research should be of cooperative cost-shared type. It is the type in which government participation can be helpful and full technology transfer effected.

As this technology is being proven most other technology advances needed will come about as the need is recognized..

Submitted by:
Lloyd E. Elkins
July 30, 1982

TABLE 1

DISTRIBUTION OF THE MAJOR WESTERN TIGHT GAS RESOURCE

Basin	Number of Sections Probably Productive	Avcrage Resource BCF/Section	Approximate Resource T C F
Denver	1600	4.9	7.8
San Juan	1188	1.9	2.3
Uinta	1184	12.9	15.3
Northern Great Plains	32730	3.1	101.5
Wind River	2280	10.2	23.3
Greater Green River	8938	9.7	86.7
Piceance	3144	10.5	33.0
TOTAL	51064	5.3	269.9

Resource is Gas in place at standard conditions.

TABLE 2

RECOVERY FACTORS CONTROLLED BY QUALITY OF PAY

(Uniformity of Continuous Pay)

Average Permeability to Gas Millidarcies	Microdarcies	(R)
.3	300.0	.85
.1	100.0	.81
.03	30.0	.77
.01	10.0	.72
.003	3.0	.68
.001	1.0	.63
.0003	.3	.59
.0001	.1	.54
.00003	.03	.50
.00001	.01	.45

Assumes abandonment pressure 10 % of initial.
Enough wells drilled to drain continuous pay.
Gas in place x (R) = Technically recoverable gas.

TABLE 3

WELLS REQUIRED PER SECTION TO
PRODUCE TECHNICALLY RECOVERABLE GAS

---Typical Blanket Sand---

Permeability Millidarcies	(B) Base Case 1000' fracture	(A) Advanced Case 4000' fracture	Ratio B/A
.04	1.4	.66	2.2
.01	2.6	1.10	2.4
.004	3.6	1.20	3.0
.001	6.6	1.97	3.4
.0004	8.3	2.38	3.5

TABLE 4

TYPICAL LENTICULAR SAND

Percentage Recovery of Technically Recoverable Gas
Per Section for Base (B) and Advanced Cases (A)

Wells Per Section	1		2		3		4		6		8		12	
Technology Case	B	A	B	A	B	A	B	A	B	A	B	A	B	A
Permeability md														
.03	22	48	53	80	74	97	90	100	--	--	--	--	--	--
.003	12	25	29	43	42	55	58	70	--	94	--	100	--	--
..0003	5	10	11	17	17	23	24	29	--	43	--	64	--	91
.00003	2	4	5	8	8	10	11	13	--	20	--	30	--	45

TABLE 5

TYPICAL PRODUCTIVITY PROFILE FOR FRACTURED
WELLS IN BLANKET AND LENTICULAR TIGHT GAS SANDS
EXPRESSED IN TERMS OF PERCENT OF 30 YEAR ULTIMATE RECOVERY

Years at Capacity Production	Blanket		Lenticular	
	Annual	Cumulative	Annual	Cumulative
1	11.0	11.0	19.0	19
2	7.0	18.0	9.0	28
5	4.4	35.1	5.1	50
10	3.2	54.1	3.0	71
30	---	100.0	---	100

TABLE 6

APPROXIMATE FRACTURE 1/2 LENGTH NEEDED FOR
EFFECTIVE DRAINAGE IN BLANKET SANDS

Permeability Millidarcies	Fracture 1/2 length feet	Length of flow path to fracture * feet	
1.0	400	1320	
.1	800	1320	
.01	1500	990	(660' for 106 acre effective drainage)
.001	2500	645	(322' " 80 " " ")
.0001	3500	484	(161' " 53 " " ")

* Assume 160 acres effectively drained

Mr. SKEEN. Thank you very much.

Mr. Benner.

Mr. BENNER. Thank you, Mr. Chairman.

Mr. Chairman, members of the subcommittee, I am Robert Benner, director of technology for SunGas. I appreciate the opportunity to appear before you today to present our views on unconventional natural gas resource development, as seen by a major domestic energy producer.

I have brought a written statement that I would like to have included in the record.

Mr. SKEEN. It will be.

Mr. BENNER. Sun Co. is a $16 billion energy resource company with integrated petroleum operations and interests in mining and other energy resources.

We are the 11th largest gas producer, and produce about 1 billion cubic feet of gas a day with major production facilities in Texas, Louisiana, Oklahoma, and New Mexico.

Since these hearings are being held in Roswell, I would like to highlight Sun in New Mexico for a moment. Sun has a substantial base of activities in New Mexico for production of gas and oil. We produce about 50 million cubic feet a day of natural gas and 3,600 barrels of oil with interest in about 500 gas wells and over 1,000 oil wells. With over 600,000 undeveloped acreage in New Mexico, we have an interest in this State's future energy production. We also have substantial reserves of carbon dioxide in the Bravo Dome unit of New Mexico.

In the first quarter of 1982, Sun's natural gas production averaged 977 million cubic feet daily. This compares to 1,086 million cubic feet daily for the first quarter of 1981. This represents a reduction of 10 percent and clearly reflects the curtailed market situation.

The gas industry is currently experiencing a natural gas surplus. This surplus or "gas bubble" can be defined as the difference between the natural gas supply capacity and the actual natural gas pipeline takes, adjusted for normal variances associated with seasonal demand.

We estimate the current domestic natural gas surplus to be around 1 TCF or about 5 percent of marketed production. We expect the surplus to remain at the current level through 1982, mainly due to the reduced economic activity.

Stepping back from the near-term gas surplus situation, the United States continues to produce its gas reserves faster than it replaces them.

Although recent increases in drilling have slowed the drop in proven reserves, the United States has not replaced its annual gas production since 1970. If you exclude Alaska, it has been since 1968.

The rise in world crude prices and the commensurate response of gas prices has changed the demand side of the energy equation. Today's forecasts of future energy needs are much lower than those made only a few years ago.

Many energy producers have adjusted their development strategies to reflect these changes in the marketplace. No one doubts that the United States will need all the oil, gas, and coal it can

find, but the timing of human and resource deployment is of prime importance to any prudent company.

Although the economic slowdown and energy surplus have affected Sun's revenues and cash flow, we do not plan any major changes in our exploration and production strategy.

However, Sun is adjusting the timing of its capital program to reflect this slowdown which includes a reevaluation of the timing of unconventional gas resource development.

Mr. SKEEN. Would you suspend just a moment, if you would.

Thank you.

Mr. BENNER. Unconventional gas resources are a part of Sun's long-term business strategy because they are part of the development of the U.S. natural gas resource base.

I will skip over some testimony here.

Sun has a reasonable land position in many of the tight gas basins and we are producing from many of the historical tight formations such as the Cotton Valley, where fracturing technology has been continually evolving over the last 10 to 15 years.

We currently have development drilling programs in the Cotton Valley, Sonora, Piceance, San Juan, and Permian basins, among others.

Sun recently started a modest effort to gain a land position and conduct developmental drilling in the Appalachian Basin as an entry to the Eastern United States tight sands.

In developing these Eastern tight sands, we penetrate the Devonian shales and although this particular area is not commercially producible with today's technology and economics, we are gathering resource evaluation data for future gas production programs from the Devonian shales.

Although there are many technological factors involved in understanding the tight formations, we believe that improved completions technology is the key to tight formation economics.

Coalbeds are both the source and the reservoir of gas formed during the process that made coal deposits. Most of the traditional hydrocarbon basins in the United States also contain coalbeds at depths too deep to be considered mineable by today's techniques.

These coalbeds often contain commercially producible methane; however, it is only recently that knowledge of this resource has been documented.

Based on limited published information, the productivities of coalbed gas wells vary considerably. Usually these formations must be stimulated and dewatered before the gas begins to desorb from the coal micropores into the cleats and fractures and ultimately into the well bore.

There is a difference in developing coal mines and its associated gas and developing coalbeds buried at depths for gas production only. We are not considering anything unconventional from that standpoint.

What about the role of technology? Well, of course, technology development is encouraged by opportunity and economics.

Technology development occurs under the waves of the major market factors, it plods along, it is needed, it has to be present, and it is hard to define a breakthrough because it is evolutionary.

99-979 O - 82 - 3

It doesn't get the hype of decontrol, or price-induced conservation, but without continuous development of new technology, you don't get the more difficult gas at the current economic prices.

Although advances in technology are continualy needed, lack of technology is not keeping us from initiating unconventional gas development programs.

Many players are involved in the development of gas production technology. Industry, universities, and government each have a role.

Many of Sun's programs come about as a result of analyzing how we apply our current technology and then pushing out the leading edge a little further with each new field program. "Technology development at the tip of the bit," so to speak.

Some research is best done by universities, for example, basic data collection on physical phenomena or mathematical modeling.

Government has traditionally been the source of funds for basic research at universities and Government laboratories. This funding helped to build not only a data base, but also a technical human resource base that supports applied research and development.

The Government's long-term funding support for unconventional gas recovery research has been a valuable contribution to the Nation.

Petroleum service companies, in response to the producer's needs, are developing new materials and equipment. We work closely with the service companies in developing and testing new techniques.

Recently Sun conducted a large-scale carbon dioxide foam fracture of a very tight sand in the Piceance Basin. Although the industry has routinely used nitrogen for foam fracturing, we are now beginning to use carbon dioxide in order to obtain higher hydrostatic heads to fracture the formations at lower surface pressures.

This particular application was a marriage of the science and techniques of the service company with the technical resources and courage of the producer.

I want to mention that I included our company's magazine which describes this foam fracture. It only happened two weeks ago in the Piceance Basin and I brought a sample of rock.

There is almost no flow capacity in this rock. And I brought other samples that show how the industry has taken something like beach sand, you could practically blow smoke through this, and then tighter and tighter formations to the point where we are trying to produce that are 100 or 1,000 times more tight than the FERC definition of tight sands.

We don't know whether it is economic yet, but we are trying it.

[In response to a view of a quartz rock, Mr. Skeen replied.]

Mr. SKEEN. They are almost of diamond quality, I guess.

Mr. BENNER. Although Sun does not have a large research and development program in unconventional gas research, it has taken the risks to try new developments in the field, which is probably typical of our industry.

Technology development is a long-term evolutionary process. We should not look for, nor expect revolutionary breakthroughs in any one area as the key to unlocking vast natural gas reserves from unconventional geologic gas resources.

However, even evolution can't occur if the environment is not conducive to creativity.

Sun plans to be an energy supplier well into the future which requires us to generate near-term income while preserving long-term resource development opportunities.

The exploration and development of new gas reserve additions has not kept pace with production, even with major increases in drilling.

Sun is interested in unconventional geologic sources of natural gas because these are a natural extension of our current business strategies and technological capabilities.

The unconventional gas resource base is mind-boggling in potential, but the realities of development are connected to current market factors, forecasts of future needs, and the financial capability of the industry.

Unconventional gas resources will be developed in the same fashion as the rest of the natural gas supplies—on a well-by-well, field-by-field basis.

These resources occur in the same geographical areas as other energy resources and the infrastructure of producers, service companies and pipelines are generally available.

Unlike the commercialization of oil shale or coal mines, for example, which are site-intensive, unconventional gas resources development should not require regional planning on a scale different than that necessary for conventional petroleum development.

Unconventional geologic sources of gas are a continuum with the U.S. conventional resource base of natural gas. Its development depends on the same issues as conventional gas development; technology, economics and access to the resource base, among others.

What's different is the degree rather than the kinds of technology required.

Based on advancements in technology and economics, gas formations are being produced today that a decade ago would have been considered unconventional.

Thank you, Mr. Chairman.

[The prepared Statement of Mr. Benner follows:]

PREPARED STATEMENT OF ROBERT I. BENNER, DIRECTOR OF TECHNOLOGY OF THE SUN GAS DIVISION OF SUN EXPLORATION AND PRODUCTION CO.

INTRODUCTION

Mr. Chairman, members of the subcommittee, I am Robert Benner, Director of Technology of the Sun Gas Division of the Sun Exploration and Production Company, a subsidiary of the Sun Company, Inc. I appreciate the opportunity to appear before you today to present our views on unconventional natural gas resource development as a major domestic energy producer.

Sun Company, Inc. is a $16 billion energy resources company with integrated petroleum operations and interests in mining and other energy resources primarily in the United States and Canada.

In the past two years, Sun has renewed and strengthened its corporate strategy which places primary emphasis on developing energy resources.

With over seven million prospective acres in the U.S. and with more than 12,000 net producing oil and gas wells, Sun is represented in most of the major onshore and offshore areas.

Attached to this testimony are profiles on Sun Exploration and Production Company and Sun Gas Division.

Sun produces about one billion cubic feet of natural gas daily from over 6,000 wells with major production facilities in Texas, Louisiana, Oklahoma and New Mexico.

Since these hearings are being held in Roswell, I thought I would highlight Sun's New Mexico activities.

Sun Company has substantial base of activities in New Mexico for the production of gas and oil and for the exploration of new energy resources.

Sun produces about 50 million cubic feet per day of natural gas and 3,600 barrels per day of oil from the San Juan and Permian Basin areas with interests in about 500 gas wells and 1,000 oil wells.

With over 600,000 undeveloped acres, Sun has an interest in New Mexico's future energy production.

Sun has substantial potential reserves of carbon dioxide in the Bravo Dome Unit of New Mexico. Sun's share of the one million acre unit could provide about one trillion cubic feet of carbon dioxide for enhanced oil recovery when this becomes economically attractive.

In the first quarter of 1982, Sun's natural gas production averaged 977 million cubic feet daily. This compares to 1,086 million cubic feet daily for the first quarter of 1981. This represents a reduction of 10 percent and clearly reflects the curtailed market situation.

The gas industry is currently experiencing a natural gas surplus. This surplus or "gas bubble" can be defined as the difference between the natural gas supply capacity and the actual natural gas pipeline takes, adjusted for normal variances associated with seasonal demand. We estimate the current domestic natural gas surplus to be around 1 TCF or about five percent of marketed production. We expect the surplus to remain at the current level through 1982, mainly due to the reduced economic activity.

Stepping back from the near term gas surplus situation, the U.S. continues to produce its gas reserves faster than it replaces them. Although recent increases in drilling have slowed the drop in proven reserves, the U.S. has not replaced its annual gas production since 1970.

The rise in world crude prices and the commensurate response of gas prices has changed the demand side of the energy equation and today's forecasts of future energy needs are much lower than those made only a few years ago.

Many energy producers have adjusted their development strategies to reflect these changes in the market place. No one doubts that the U.S. will need all the oil, gas and coal it can find, but the timing of human and resource deployment is of prime importance to any prudent company.

Although the economic slowdown and crude oil surplus have affected Sun's revenues and cash flow, we do not plan any major changes in our exploration and production strategy. However, Sun is adjusting the timing of its capital program to reflect this slowdown which includes a re-evaluation of the timing of unconventional gas resource development.

Sun has reasonable land position in many of the tight gas basins and we are producing from many of the historical tight formations such as the Cotton Valley, where fracturing technology has been continually evolving over the last ten to fifteen years.

We currently have development drilling programs in the Cotton Valley, Sonora, Piceance, San Juan and Permian basins, among others.

Sun recently started a modest effort to gain a land position and conduct developmental drilling in the Appalachian Basin as an entry to the eastern U.S. tight sands. In developing these eastern tight sands, we penetrate the Devonian shales and although this particular area is not commercially producible with today's technology and economics, we are gathering resource evaluation data for future gas production programs from the Devonian shales.

Although there are many technological factors involved in understanding the tight formations, we believe that completions technology is the key to tight formation economics.

Coalbeds are both the source and the reservoir of the gas formed during the process that made coal deposits. Most of the traditional hydrocarbon basins in the U.S. also contain coalbeds at depths too deep to be considered mineable by today's techniques. These coalbeds often contain commercially producible methane; however, it is only recently that knowledge of this resource has been documented. Based on limited published information, the productivities of coalbed gas wells vary considerably. Usually these formations must be stimulated and de-watered before the gas begins to desorb from the coal micropores into the cleats and fractures and ultimately into the well bore.

Sun participated in a 1976 industry study to understand the theory of methane in coal and its potential for production from unmineable coalbeds. Out of this study grew a number of separate resource assessment studies and finally a business venture by some of the participants.

From 1979 to 1982, Sun was in a joint venture to evaluate the methane potential of the Warrior Basin coals at currently unmineable depths. The project was abandoned as uneconomic; however the field program produced valuable information and techniques useful to subsequent programs.

Geoscience studies are underway to examine the coalbed methane potential on Sun's acreage with current activities centered in the western U.S. basins.

This geoscience program is developing techniques for examining coalbeds as both source and reservoirs for methane gas. In this regard, we are working with the Colorado School of Mines and the University of New Mexico, among others to develop sampling and resource delineation procedures.

We have actively monitored the government's programs in coalbed methane recovery from eastern mining operations and believe these DOE efforts provided valuable information not only for mine safety programs, but also for industry's efforts to develop this resource as a viable gas supply.

Many players are involved in the development of gas production technology. Industry, universities, and government each have a role.

Many of Sun's programs come about as a result of analyzing how we apply our current technology and then we push out the leading edge a little further with each new field program. "Technology development at the tip of the bit", so to speak.

Some research is best done by universities, e.g. basic data collection on physical phenomena or mathematical modeling. Government has traditionally been the source of funds for basic research at universities and government laboratories. This funding helped to build not only a data base, but also a technical human resource base that supports applied research and development. The government's long-term funding support for unconventional gas recovery research has been a valuable contribution to the nation.

Petroleum service companies, in response to the producer's needs, are developing new materials and equipment. We work closely with the service companies in developing and testing new techniques.

Recently Sun conducted a large scale CO_2 foam fracture of a very tight sand in the Piceance Basin. Although the industry has routinely used nitrogen for foam fracturing, we are now beginning to use carbon dioxide in order to obtain higher hydrostatic heads to fracture the formations at lower surface pressures. This particular application was a marriage of the science and techniques of the service company with the technical resources and courage of the producer.

Although Sun does not have a large research and development program in unconventional gas research, it has taken the risks to try new developments in the field, which is probably typical of our industry.

Technology development is a long term evolutionary process. We should not look for, nor expect revolutionary breakthroughs in any one area as the key to unlocking vast natural gas reserves from unconventional geologic gas resources. However, even evolution can't occur if the environment is not conducive to creativity.

Sun plans to be an energy supplier well into the future which requires us to generate near term income while preserving long term resource development opportunities.

The exploration and development of new gas reserve additions has not kept pace with production, even with major increases in drilling. Sun is interested in unconventional geologic sources of natural gas because these are a natural extension of our current business strategies and technological capabilities. The unconventional gas resource base is mind boggling in potential but the realities of development are connected to current market factors, forecasts of future needs, and the financial capability of the industry.

Unconventional gas resources will be developed in the same fashion as the rest of the natural gas supplies—on a well by well, field by field basis. These resources occur in the same geographical areas as other energy resources and the infrastructure of producers, service companies and pipelines are generally available. Unlike the commercialization of oil shale or coal mines, for example, which are site intensive, unconventional gas resources development should not require regional planning on a scale different than that necessary for conventional petroleum development.

Unconventional geologic sources of gas are a continuum with the U.S. conventional resource base of natural gas. Its development depends on the same issues as conventional gas development; technology, economics and access to the resource base,

among others. What's different is the degree rather than the kinds of technology required.

Based on advancements in technology and economics, gas formations are being produced today that a decade ago would have been considered unconventional.

Sun Exploration and Production Company manages the worldwide oil and gas exploration and production activities (except in Canada) for Sun Company, Inc. Sun Company ranks 11th among domestic energy companies, 17th among all publicly held American businesses and is one of the top 50 corporations in the world. In 1981, Sun Company had revenues of $16 billion, more than $1 billion net income and a 23 percent return on stockholders' equity.

Sun Exploration and Production Company produces about 210,000 barrels of crude oil, condensate and natural gas liquids daily, along with 1.1 billion cubic feet of natural gas. Proved developed reserves on Dec. 31, 1981, amounted to 584 million barrels of crude oil and condensate, 77 million barrels of recoverable natural gas liquids and 2.724 trillion cubic feet of natural gas from properties in the United States and overseas.

With 5,400 employees worldwide—2,300 in the North Texas Metroplex—Sun Exploration and Production Company accomplishes its objectives through three Dallas-based operating divisions. Sun exploration searchers for and proves commercial oil and gas reserves and offers expertise in exploration and production services on contract to foreign national oil companies. SUN GAS produces, processes and markets natural gas and natural gas liquids. Sun production acquires and develops reserves and produces and markets oil.

SUN EXPLORATION DIVISION

800 employees worldwide.

Offices in England, Scotland, Singapore, Venezuela, Algeria, Texas, Oklahoma, Colorado, Louisiana, Mississippi and California.

Nearly 7.2 million net undeveloped acres in the United States with an option on an additional 1.4 million undeveloped domestic acres.

Domestic interest in Western Overthrust Belt, Williston and Anadarko Basins, Santa Barbara Channel, Gulf of Mexico and the Baltimore Canyon.

Overseas interest in the North Sea, South China Sea, Sudan, Tanzania and Bangladesh.

SUN GAS DIVISION

2,000 employees nationwide.

Interest in about 50 offshore production platforms in Gulf of Mexico. Operations or marketing properties in Texas, Louisiana, Oklahoma, California, Colorado, Mississippi, Wyoming, Arkansas, Alabama, Ohio, Michigan, New Mexico, Utah, West Virginia, Virginia, Illinois, Maryland, Montana and Pennsylvania.

Interest in some 6,600 active gas wells and more than 80 natural gas processing plants.

SUN PRODUCTION DIVISION

2,600 employees nationwide.

Operates two oil production platforms in Santa Barbara Channel. Production properties in Texas, Oklahoma, Louisiana, Mississippi, California, Kansas, Kentucky, Illinois, Michigan, Colorado, Wyoming, Montana, Florida, Arkansas, Nebraska, Indiana, Alabama, Ohio and New Mexico.

Interest in more than 37,000 oil wells.

SUN GAS PROFILE

Mission: To produce and process natural gas; market natural gas, gas liquids and energy-related services; and develop growth opportunities in the energy business.

Industry rank: Sun Gas, a division of Sun Exploration and Production Company, is among the nation's top dozen suppliers of natural gas products. Sun Exploration and Production is a unit of Sun Company, the 17th largest company in America and among the top 50 in the world.

Employees: Approximately 2,200.

Offices: Headquartered in Dallas, TX. District offices in Houston and Corpus Christi, TX; Oklahoma City, OK; and Lafayette, LA. Project development offices in Houston, TX, Tulsa, OK; and Denver, CO. Wholesale marketing offices in Corpus Christi and Snyder, TX; West Memphis, AR; Montgomery, AL; Toledo, OH; and Wayne, PA.

Operations: Production offices or processing plants in 7 states, active wells in 11 states, and an interest in 52 offshore production platforms: Interest in 7,946 active wells (2,501 Sun Gas operated); 1.1 billion cubic feet of natural gas produced daily; 28,000 barrels of oil and condensate produced daily; interest in 81 gas processing plants (28 Sun Gas operated); 775 million cubic feet of natural gas processed daily; and 40,000 barrels of gas liquids extracted daily.

Marketing: Natural gas is sold primarily to pipelines that, in turn, supply gas to hundreds of thousands of consumers throughout the country. Natural gas liquids (propane, butane, ethane) are sold to wholesale customers and used in Sun refineries. Average daily sales of natural gas and natural gas liquids: 887 million cubic feet of natural gas; and 69,000 barrels of natural gas liquids.

BIOGRAPHICAL SKETCH

Robert I. Benner received his formal education at Drexel University in Philadelphia, Pa., where he graduated with a B.S. in Chemical Engineering in 1964 and an M.S. in Chemical Engineering in 1966.

His career with Sun Company began in 1965 as a process development engineer in petroleum refining research. He holds six U.S. patents. From 1971 through 1977 he was active in the engineering management of projects related to oil shale, coal gasification, solar energy and natural gas conversion technology.

In 1978, Mr. Benner became Manager of Business Development with responsibilities in long range planning, natural gas market analysis and unconventional gas resource development. In 1980 he assumed his present duties as Director of Technology for Sun Gas.

Mr. Benner is a registered professional engineer in the state of Texas and a member of the American Institute of Chemical Engineers, Society of Petroleum Engineers and the American Petroleum Institute. He is also involved in civic, educational, sports and religious activities in the Dallas, Texas area.

Mr. SKEEN. I want to thank each of you. I was going to offer the courtesy of the first question to Mr. Sensenbrenner, but he disappeared.

Let's go back to the beginning. This is the first time I have had a clear concept of what we are talking about in tight sands formations.

It is just mind boggling that the technology has advanced as rapidly as it has. I can see, too, that the risks coincident with this kind of activity are tremendous because if you are out there drilling a 15- or 30,000-foot hole, you are talking about a lot of money and also if you have hydraulic techniques such as Mr. Elkins described—that also amazed me.

This is the first time I have grasped how significant this is. You have talked about 2- or 3- or 4,000-foot fractures in an existing structure because it takes not only the ability to analyze what you are into, how it lies and so forth, it is how you are going to make the flow, and that was interesting on the multiwell concept.

Is there a better way than what we are doing to predict where the deposits occur?

Mr. GOLD. Yes; I think great improvements are possible in predicting where deposits of deep gas exist and where they are very large.

I should tell you that in Oklahoma, for example, we have clear evidence of a location in which something of the general order of 20,000 TCF of gas must once have escaped just to give you some idea of the quantities that are involved in the telltale markers that are left in the ground, where enormous amounts of gas have escaped.

I am seriously talking about 20,000 TCF being necessary to have produced the markings in the ground we can find there. The

search for the escape routes of the gas will become a very major method of prospecting because if, in addition to understanding the internal structure, as you do to some degree from the seismic profiling, in addition to that, if you know where the seepages of gas happened in the past, then you are in a very much better position to judge where an amount will be maintained in the ground on the way up.

For oil seepage, most oil was discovered merely because people saw the black fluid come out of the ground somewhere. Gas is not so easy, because it seeps out in huge quantities somewhere and nobody knows anything about it.

So therefore, one needs to get into a corresponding situation for gas, one needs a new technology that allows you to find the little traces that the gas leaves in the ground by which to discover where it seeped.

That can be done by modern methods of microchemistry in the search for very small quantities of trace elements brought up with the gas.

That work should be done on a substantial scale. One should not have a single area in which gas is recovered without knowing the trace element contents of this completely and thoroughly.

It is a shame not to use all the information that the ground is able to give us. Then one must develop new tools with which better to measure quickly in the field the trace element contents.

Mr. SKEEN. In our testimony, you mentioned that Los Alamos is doing research.

Mr. GOLD. There are some ongoing research related to this.

Mr. SKEEN. In trace elements.

Mr. GOLD. There is some, yes.

Mr. SKEEN. And Sandia in the drilling area?

Mr. GOLD. They make improvements in drilling bits; yes.

Mr. SKEEN. Is this a cooperative research and development or is it funded through the Department of Energy?

Mr. GOLD. Department of Energy funding and independent funding.

Mr. SKEEN. There is just one other question, how can an astronomer get interested in tight sand gas formations?

Mr. GOLD. I have been asked that before.

Mr. SKEEN. I figured you had.

Mr. GOLD. I am interested in the first place in the processes that put together the planets and that allowed them to develop in the way in which we now know.

That includes understanding about the volatile substances, where they came from on the different planets, you see, so one of the planets we have to investigate is the Earth; and in doing this, I realized that there was a great deal of importance attached to that, not only from the scientific point of view, but also from that of applications.

Mr. SKEEN. Thank you very much, I appreciate your testimony

Mr. Elkins, you mentioned the multiwell concept. We have a project now going on under the Department of Energy and we are having a tough time with the funding situation as we are in all these departments. Would you tell me, give me some background on that one project.

Is that a two hole or three hole or what? We are not talking about something else?

Mr. ELKINS. I know what you mean. It started out 3 or 4 years ago to be a five- or six-well project. Its budget was cut two or three times, got back to two wells and now they hope that if the funding comes along, as the Senate is indicating, maybe they can go to three wells.

But the essence of it is that this is something that has to be done in the field, this is a project funded by the Department of Energy. In the future it does not matter if it is the Department of Energy or cooperative projects of industry and Government, the important thing is that it has to be done.

What we are trying to do is get a geological model of a lenticular section. One thing they might do is check on whether or not you can make a fracturing, start in shale and then actually enter a gas sand 100 or 200 feet away from the well or 1,000 or 2,000 away in the long range. Or, they can start a fracture in the shale zone and send it out and put it in production and if they don't get production, they know they didn't get into a sand zone. This is a preliminary pilot test of the kind of research that has to be done, not just in the Piceance Basin, but down in parts of the San Juan Basin here and all over the West.

You are going to do a dozen of these, actually, at some time in the future. The best way is a cooperative way, hopefully the Government can help out on this partly with money, and industry can also contribute. If the Government is in the lead, some of the major companies who don't like to get into cooperative research because of antitrust aspects, will participate with technical advice and then everybody benefits. Industry can then plan, 5, 10, 20, 35 years down the road.

There is one other point I would like to make, the gas in the tight gas sands and generally speaking, it is being generated at the present time. It is a different type of gas than Dr. Gold is thinking about although some of that gas can get up into sedimentary rocks and that is where we like to find it. But it is a different course entirely. The fact is I think that in the reservoirs in the tight gas, particularly up in Wyoming, it is pretty well understood that the gas is being generated now and it can't get out, so it builds up pressure.

Mr. SKEEN. Some other questions occurred to me during your testimony, what kind of fracture pressures are you talking about generating? You mentioned you use nitrogen.

Mr. ELKINS. Yes, we did.

Mr. SKEEN. I want to ask Mr. Benner to get into this multiwell discussion if he would.

Go ahead.

Mr. ELKINS. It is one of the key questions in fracture design, it takes a pressure of about eight-tenths of a pound per foot of depth in order to break through the initial break in the rock.

Once you start the fracture, then the pressure will fall off a while and it will fall off quite a while as it is going on out until finally it starts building up again.

But for a 10,000-foot well, you probably have to have a bottom hole pressure of 8,000 pounds. But when you put the pressure at

the surface and friction drop, it requires a lot of hydraulic horsepower. The environmental people are very concerned about a job like this so they make you put in 500,000 to 1 million gallons and 2 to 4 million pounds of sand. It is all brought out there 2 or 3 days in advance, the job is done in 10 or 12 hours; and in 2 or 3 days, all you have is a wellhead left. Everything is cleared out and taken away.

But it does take a lot of equipment to do the job. Sometimes the fracture job costs more than drilling the well itself.

Mr. SKEEN. I was interested in the aspects of the multiwell concept that would sustain the production; it is essential that you go to a multiwell concept, is that correct, in the way you handle fracturing and so on of the tight formations?

Mr. ELKINS. In that line, in the multiple-well side, in the real tight formations, the very, very tight ones, the kind you had your hand on up there a few minutes ago, if you put out a fracture 3,000 feet, in each direction, uniquely nature says that fracture in a certain region will go in a certain direction, that is northeast-southeast. Well, you need to know what direction it takes, and it can be measured, so if you drill a second well 600 feet away, you don't want that fracture to penetrate the one you have drilled.

Locate the wells so all the fractures line up in the same direction. They will line up in the same direction, you just have to know what direction it is. And this is a fascinating part of working with the high technologies involved in these projects.

Mr. SKEEN. What I was interested in is, does Sun have a policy or are they doing any multiwell work or participating in any kinds of productions of this type?

Mr. BENNER. Yes, of course we are doing fracturing as part of our normal production techniques. Most, maybe not most, but many more gas wells today require fracturing or acidizing to open up formations than in the past.

I was showing the rock samples on the table. If I could show you the first sample, it would be like taking grains of sand and pushing them together; but I have a way for the fluids to flow through. This rock didn't require fracturing. This is the John Wayne gusher, you drill, and you get oil and gas. You get to the hard ones, 10,000 15,000 20,000 feet, requiring tremendous surface pressures to put away large volumes of proppant material, and you are talking about a very expensive operation, requiring a lot of time.

You drill one well in a field to find out what will happen. If it is successful, you drill another one. The idea of doing a multiwell experiment with lots of research in the well is very difficult for industry to undertake.

Even Sun has only a 2-percent market share of the total U.S. gas. Everybody is small in this business. Our production people, when they drill, they want to get fast to the bottom, the driller wants to get down there and get out.

The guy that will complete wants to get in and out, the production guy wants to get it on production and sell it, and the research guy says, wait for me, I want to get some data.

So it is hard going. That is why something like the multiwell experiment done by the Government on contract with Sandia Labora-

tory—Dave Northrop will tell you more about that—along with advisers, are valuable contributions to the industry.

A lot of us have techniques, but the wherewithal to do a multiwell experiment just doesn't rest in our research budgets.

Mr. SKEEN. Thank you.

Mr. Sensenbrenner.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

I think, as we all know, the bottom line in all of what we are discussing here is whether gas can be extracted from the ground in a cost-effective manner. Given Dr. Gold's theory of the large amounts of gas yet to be discovered and put into production, assuming we are able to find ways to locate the gas, do you see the private sector putting the money into exploration and development of the new gas, Mr. Benner, that Dr. Gold told us about?

Mr. BENNER. That is a good question. Let me back up and talk around it and to it, if you will. If you talk about something like what is called abiogenic or nonorganic origin of gas, you may have some different theories on your hands that people will disagree about.

Once you get to the point where you say if that gas is there and it is buried deep, but over large amounts of time it has started to migrate through the thousands of feet of rock in the Earth and come to the surface, if there is evidence a lot has escaped, there is a good chance a lot of it still exists.

In places where we wouldn't normally look for it, it would exist because we don't consider it to be from organic deposits. So you get new ways of looking for gas. You say maybe I ought to have new tools that are looking for vertical migration of gas and just look for evidence, for example, geochemistry, that the gas exists. Tools like that are being developed by the major companies.

I think they are in the research stage yet, discussions of the theory are at the leading edge. In order to test the theory, you have to have very deep drilling. That is expensive.

I think at this point, there is a lot that needs to be done. I think I might have missed part of your question in my answer, but we do a fair amount of deep drilling. Deep is 10,000 to 15,000 feet, ultradeep may be to 20,000-plus. But that is the limit. There aren't many wells drilled to that depth.

I think research is appropriate, not only for government funding, but because it is basic research, looking for the proving of the theory. Dr. Gold and I just met a few years ago at an international gas research conference and frankly, I was taken with his presentation on the evidence for this around the world.

It is something worth while thinking about.

Even if it is not totally right, there is sufficient evidence to say it is worth a try, worth putting money into.

Government has been the traditional funder of basic university research and, of course, their policy is to back out of things that industry can do.

But I think the transition to no funding has been so fast that industry hasn't been able to pick up the slack.

That is a problem.

I can't say what is right. As private industry, I am free market and less Government oriented, but at the same time, there are

places where the Government really has a role when it comes to high-risk, high-national-interest research, especially concerning basic energy resources.

It has been said before that the gas industry doesn't get nearly its share of energy research dollars compared to coal or electric.

Mr. SENSENBRENNER. What research do you, Mr. Benner, or you, Dr. Gold, believe are necessary to make recovery of these resources possible? Perhaps Dr. Gold will address that.

Maybe he will put you on the hot seat first.

Mr. GOLD. Well, a great many areas that I would like to be able to pursue and would like to see pursued much more than is done now, yes, but, of course, some of this would include exploratory drilling. But exploratory drilling to depths that unfortunately cost you $10 million a hole.

I would very much like for the Government to take part in exploratory drilling on a fairly significant scale. The resource that we are discussing is so enormous, even compared with a few times $10 million, that it is well worthwhile going for it in a big way.

On the research side, as I have said, the whole spectrum of chemical investigation is in its infancy. One knows of certain chemical relationships with hydrocarbon deposits that one in the past has not been able to explain, that I claim in my viewpoint becomes understandable, becomes meaningful. In the past, the geochemical prospecting has not been pursued because it seems that it ought not to work.

Even though clear demonstrations existed where it would have worked, one did not like to use it because it didn't make sense.

In my view, these geochemical methods become really significant and therefore, there is a huge new field to be opened up.

I think Dr. Benner is aware of this and has alluded to it and we are clear about the fact that research programs of certainly tens of millions of dollars a year would be well worth it for improving the understanding of the geochemical situation and for improving instruments with which to exploit it.

Mr. SENSENBRENNER. Mr. Benner, I would like you to answer my question and give us information on how much money your company is spending in this area if you could?

Mr. BENNER. All right. Let me first talk about the philosophy of who should fund what and what are some analogous programs.

I will use the geopressured brines as an example. There is a resource that has had a lot of press, if you will, over the last 5 years, tremendous quantities of gas exist in the deep geopressured brines of the gulf coast.

They may, in fact, be there. We know that they are there. But will it be recovered? Can you recover it at today's prices or at economic prices at any point in time?

So the program was under way to understand them better. What is the resource, how big it is, how did it form, how do you produce it?

The Government put together an excellent program and part of that program was to drill a couple of design wells to the depths required to test the formations, wells that cost in the range of $10 to $15 million.

Industry doesn't drill wells like that just to test how much resource, how much hot water is at 20,000 feet. We drill a number of wells in the Gulf Coast and we do penetrate the geopressured formations, to us, it is more of a problem than an opportunity to deal with at this time.

However, when we drill those wells, we now have penetrated something that someone else might be interested in testing and as part of the Government's program, there was the wells of opportunity program. If companies like ours have a well that we have abandoned for one reason or another, then the Government, using a contractor, could come in and test your well.

Those wells were $1 million to a few million dollars to test. It was much less than the $10 or $15 million each to drill the Government wells.

That is the type of applied research cooperation between Government and industry that can take place where it is less of your dollars, which are our dollars, too, and it is learning something about future resources that have large potential for the country, yet are in a time frame of development that are still some years away.

Maybe the same thing applies here to abiogenic gas. There is a lot of basic research that can be done at universities, contract laboratories, whatever.

That can be done in conjunction with industry advisory panels, working on how to test these theories?

One that comes to mind, I believe Dr. Gold will reflect on this, is Gulf has research under way with one of the western labs looking at gas coming out of the sea floor and trying to test—it is out of the——

Mr. GOLD. The San Andreas Fault.

Mr. BENNER. Yes; and using techniques to test for elements that may show evidence of abiogenic gas. That is fairly low cost, from $10 million standpoint anyway, that is very practical and helps build the data base for future actions.

How much is right, I can't tell you right here.

But there is a lot we have to do to crawl before we walk and run in some areas. That ought to be funded some by industry, and maybe some by Government.

In terms of our own research, Sun has three divisions within our Sun Exploration and Production Co. We have an exploration company that does a lot of geochemical research.

I don't know what their budget is offhand, but I can tell you over the last 10 years, we have increased our work and resources in that area tremendously compared to what it was even 10 years ago. It is building.

We understand the value of that. We are doing more of it.

Mr. SKEEN. Thank you. I want to take this opportunity now to ask the staff if they have questions they would like to ask.

Dr. KREBS. Yes, I do.

One of the things I am interested in asking Dr. Gold about is the abiogenic gases. Obviously, this is the sort of thing that is not something that would be of contribution to our domestic energy resources.

It possibly has as much or more contributions in the developing countries. The implications of that is not so much that they have

maybe become a possible source of energy for us, but simply that they are not nearly as dependent on imported oil and then it would prevent the geopolitical threat.

Do you see that as something we can do in terms of developing our own resources which might have an effect on them.

Mr. GOLD. Absolutely, I feel very strongly about the point you allude to. The sort of fever in the world that is created by the energy shortage is a very severe threat to the world at the present time and I feel that it could be cooled off considerably if a number of countries that are now very short of energy and dependent on OPEC supplies, could produce their own.

They are not in the position in most cases to do their own research into this whole area. It is expensive and it looks a long way off, it is a long shot.

From this point of view, if the subject were progressing in the United States so one understands how to do it, one has the techniques, it would be much easier for them to get into the act.

I have been in recent times very interested in Japan because I believe Japan, which is, of course, the world's principal importer of energy, has a very good chance of finding its own deep gas. The geologic situation there seems to me particularly favorable but it has not been tested, even in wealthy Japan.

Of course, the U.S. leadership in this would be a major step in producing such research and exploration in many countries.

In Europe, as I alluded to a moment ago, I feel that if we had gone out of our way, perhaps even at substantial U.S. Government cost, to assist the Europeans in finding their own deep gas, it might have been a very much better way of discouraging them from laying the pipeline to the Soviet Union than what we are doing now, which is trying to step on them, not to let them lay their pipeline.

I feel certain that France and Germany could find their own deep gas, also, but again, very, very little has been done in the way of deep drilling

Don't believe people who say, well, we have explored thoroughly and there is nothing there. You have to investigate to what depth, how many holes, and you find that Europe is nowhere in the search for deep gas.

It is not known whether any exists because it has not been seriously looked for.

Dr. KREBS. Thank you.

Mr. SKEEN. Mr. Wallace.

Mr. WALLACE. I have one question, I wanted to start out with Mr. Benner.

In your testimony, you note that Sun Co. helped fund development of a hydraulic fracture simulator. To date, 18 major international producing companies have funded its development. Could you comment a little more on that, what it is, how it operates and how you know it is accurate?

Mr. BENNER. That is a good question because it opens up a whole area that Mr. Elkins alluded to.

It is one thing to try and crack a rock, it is another to say if I crack it, where is the crack going, and how large is it going to be, how wide, how deep, how long?

If I put in a proppant where will it go? How much will stay there? Will it settle out? Will it fill the fracture? How much gas will be produced, or oil, when that fracture occurs?

Well, one way to do that is to build a simulation of the whole matter. These have been developed over a long period of time.

Some of the models are very complicated and some of them require that numerous companies get together in cooperation on the model.

This happens to be a two dimensional model. If there is a crack in two dimensions, what happened?

Well, we extended the model to three, dimensions what happens not only vertically but how far does it go?

When you come in with computergraphics, you start getting phenomena of what happens under the ground. Every one of the rocks here is different. One of the things we have under way is some work at Massachusetts Institute of Technology, and hopefully we will get programs going at the University of Texas, among others, to look at rock phenomena research on what happens when you apply a pressure to a rock, will it open, will it stay open?

This type of research is part of the mathematical modeling. Having the models by themselves are research tools, how does the man in the field use it?

Well, to convert that into something useful you have to have a data base. This rock, what about that one, or that one, what about that rock in its form but in another state, another location? Building that data base for production people and getting the information to them, training them in how to use the models, is really all part of the research. If you could picture it as a technology pie, it has lots of ingredients in it, the actual research is just a small slice of the pie. The actual transfer of that technology to the user is the biggest part of the pie and a lot of times the hardest because we are used to doing things the old way. A lot of techniques have been available for years but it will be a long time before they are applied in the field because they are costly, the instruments are not available, and so on.

Transfer of technology is probably as important as technology itself in coming up with new technology.

Mr. WALLACE. How does this relate to the multiwell experiment? Would something like that be useful?

Mr. ELKINS. Well, the multiwell experiment is aimed primarily at getting the data that would go into a simulator model like that. I wanted to make another point. The wells are only 100 or 200 feet apart. They are not intended to be commercial producing wells. They drill one well to see what the section looks like, they drill another to see what it looks like there, how different it is. In one well—this is an important point the breakdown pressure of a shale zone which is just above a gas pay is a question mark at the moment. But in one place up in Wyoming where they have actually done the test, they find out the breakdown pressure of the shale, the zone above the gas pay was 1,000 pounds higher than in the gas zone. That is what we want to see because that means you can start a fracture in the gas zone and it won't break out and go wildly up above.

If it was equal, you couldn't control that fracture. But the only way you can get there—I won't say the only way—the best way to get that is a minifracture test where you pump 25 gallons of fluid in and get the pressure and closing pressure of a zone and do it in another. That is what they did up there in Wyoming. But this has to be done in 20 or 30 cases around the country to get a feel for significance.

Then you can go to the model, the fracture design model and the other types of models and you have real good data for it.

Dr. KREBS. One of the things that I am curious about is the multiwell experiment. If it works it gives you a lot of information but it really only gives you a lot of information about one place.

Mr. ELKINS. Precisely.

Dr. KREBS. How many more multiwell experiments would the Government have to pay for? If this works out and it looks like you have a good and interesting data base, are we at the point where the private sector might pick up their own experiments?

Mr. BENNER. In a way we do our own multiwell experiments. You couldn't call it a multiwell experiment but each time we go in and fracture a well, we play with our simulator model, we say based on what the model tells us we will do this, pump away so much sand and so much fluid, and it is going to flow back and we will test the production. If the production matches what the model says, we say it looks like we did a pretty good job. That is a one-well experiment.

The next time we do a well in that field, if it is commercial, we have another data point and another data point and finally there are wells or fields like the San Juan or Permian Basin where you get to know it like the back of your hand for some formations.

The other thing is back at the laboratories at the State geologic surveys, at the schools, they are doing experiments with rocks to find out what the fundamental parameters of the rocks are and as a result, once you understand how one rock reacts, you can extrapolate to another set of rocks. So each time you get a piece of data it goes to build the total data base.

How many more multiwell experiments? I do not know. Depends on when you think you have learned it all.

Mr. SKEEN. Mr. Benner, you are developing a so-called data base that gives you some predictability under the types of formations of a general classification area so you can have predictability out of each one of the wells.

Mr. BENNER. Yes.

Mr. SKEEN. Or are they so unpredictable that you can't?

Mr. BENNER. It is not totally unpredictable. No, it is not.

Mr. SKEEN. Questions?

Mr. LAMINA. From an economic standpoint, how do you feel the deregulation of the price of natural gas will affect the gas industry's ability to invest in these new technologies?

Mr. BENNER. Well, of course, decontrol of natural gas would be good. Phased decontrol would be probably good for the economy and good for the producer. Natural gas is the last major energy source we have that is still controlled. When you have decontrol and energy is priced—competitively then, we have drilling opportunities in lots of places—we are in high-, low-, and medium-risk

areas—we are wherever we can be to balance our portfolio of drilling prospects if you will. When the prices are decontrolled, things begin to even out and it might not be quite as economic to go to deep gas but better to go for shallow gas. But each prospect has its own economic threshold and you are not playing games with the system via Government control. So there is market ordering that takes place.

The other thing is that research budgets are very seldom tied to what is happening today in the marketplace. Most research budgets are sustained over long periods of time and that is what allows you to plan 10 years in advance. We are doing things today hopefully that will help us 10 years from now. Most of our research is aimed at helping the guy in the field to do technical service to solve today's problems? Even if gas was decontrolled, this is the bottom line, would we have a step change in research? No, probably not, mainly because research is not just money. It is talent.

Where do we get that? We get it from the schools, but the schools only turn out so many people. So there is a continuum there, an evolutionary process. You don't turn evolution on and off because of regulation or deregulation of some other step change in the system. Research is affected by not providing the funds either in your own company or from the Government to whatever places they think are important.

Mr. GOLD. May I say something to the same point?

Mr. SKEEN. Anybody that wants to jump in on deregulation just go right ahead.

Mr. GOLD. I feel this about deregulation: If one is in a situation where there has been regulation before and one deregulates, then even if one is entirely enthusiastic about the deregulation in the end being the right solution, as I personally feel, one has to be cautious as to what can happen in the act of getting out of the regulated system and this can create severe problems, and there is a risk it will do so here.

When you speak about deregulation of the price of gas, are you speaking at the same time about deregulation of its usage? Is the market free and open right away? If you are deregulating the price of all gas but you are constricting the market artificially by telling the gas producers they cannot supply the market of, shall we say, power stations in California, then you are not in a completely deregulated situation.

If the market for gas has not expanded into the areas in which it would and should be competitive with imported oil, then the sudden deregulation of all gas will initially produce the clear result of putting the expensive gas in competition, not with the imported oil which is what it should be in competition with, but put it in competition with the cheap gas that is still there that can be pulled out quickly in substantial amounts but only for a short time.

Then in a future years you will have stopped the deep drilling completely because nobody is going to risk deep drilling in competition with $3 gas, and then in a few years you will regret it very much because you will have interrupted the process of searching for deep gas and the shallow gas will of course indeed dry up.

So the order in which deregulation takes place is a very important one. My feeling is that in the first place the market for gas

99-979 O - 82 - 4

should be expanded vigorously to include all usage where gas is in competition with imported oil and that includes power stations and large users.

Then when the market has expanded due to this abolition of all restrictions, then you can safely deregulate all gas.

Mr. SENSENBRENNER. Dr. Gold, haven't you forgotten one other fuel in this equation and that is coal?

One of the reasons why power companies in my part of the country are not using either gas or nuclear fuel is because coal is now the cheapest way to generate electricity on a per kilowatt basis. I think taking this one step further and harkening back to testimony this subcommittee received, looking at new uses of coal, is if you take away a lot of environmental regulations, the scrubbers and smokestacks and things like that, we would really have an unlimited source of energy by use of coal and of course the other side of that coin is that the environmental situation would go down, we would have acid rain problems, et cetera.

When we are talking about using the marketplace to determine what fuel is to be used, we have to use coal as well, don't we?

Mr. GOLD. In some areas you can use coal, but you have to calculate the expense correctly, not just the price of energy from coal but the price of the environmental restrictions which you have to live with, the price of the introduction of coal in terms of cleaning up problems. These restrictions are not going to go away. They are going to get tougher.

In some places coal is just not usable even if you do all the scrubbing in the world. California is one place. California's power requirements are substantial. Gas can be used in those locations.

My feeling is that coal will not become the fuel of the future, even though we may use it for some time. Its environmental problems are very much more severe. Also, the problems of creating a new generation of miners is pretty terrible to face up to.

I believe that the drilling for deep gas will become substantially cheaper and the use of coal will turn out to be substantially more expensive, and those two curves in a few years will cross. In any case, you must consider all the areas in which you cannot use coal and they would provide a substantial market for gas already.

Mr. SENSENBRENNER. Thank you.

Mr. BENNER. If I could say a few words about coal.

Our company is a major producer of coal, also. Frankly, when you are talking about gas technologies, you cannot rule out that America's ace in the hole for gasification is our coal resource. At some point coal gasification from one major western field, even though it is very capital intensive, has major socioeconomic impacts, major ecological impacts, the economics and the technology say that you might be able to produce one heck of a lot of gas from coal compared to drilling a lot of deep wells, depending on what you define as deep.

That is not shown yet. I think we have to follow all these possible energy futures.

Mr. SKEEN. I want to thank all three of you. I would just like to ask one final question in summary.

Are the Soviets using deep-drilling techniques? Do any of you know?

Mr. GOLD. The Soviets are exploring deep drilling very thoroughly. They are in two locations with it and they have the deep-drilling world record at the present time. This is not for production but purely for exploration. They have indeed found that methane is the predominant gas at the great depths in both locations, in this case, in igneous rock in places where the conventional discussion would not have expected it at all, and in the pressure situation which is very much the one we envisaged to be the common one.

But on the production side they have so much shallow gas that it is just not worth their while to go in for deep drilling. They have much more shallow gas than they know what to do with, as you know.

On the other hand, the viewpoint that the deep gas, the abiogenic deep gas, exists is a view substantially represented among the experts in Moscow, in the petroleum institutes in Moscow and leading places, very much more represented than it is here.

I seem to be a fairly lonely voice. I have acquired some support, but a lonely voice stressing this point. In the Soviet Union there are very substantial groups and leading groups in the field who believe very much the same as I do.

Mr. BENNER. Although Russia has the two deepest wells in the world as far as I know, they do not lead in drilling technology or productivity of drilling, that is still the United States.

Mr. GOLD. That is right.

Mr. SKEEN. Again, I think that illustrates what we see going on in the United States. We lead in a technology, we have the first step up, we are the progenitors of this kind of a process and so forth, but so little is known by the Congress, first of all, or by the people in general, about what it takes to produce.

This has been an extremely good contribution to our base knowledge and I appreciate very much the time and effort that you gentlemen have given us this morning.

If it is all right, why do we not take about a 5-minute break and come back for the second panel.

[Recess.]

Mr. SKEEN. My colleague, Mr. James Sensenbrenner, the Congressman from Wisconsin, will do the introductions.

Mr. SENSENBRENNER. Thank you very much, Joe.

The second panel we have today includes Mr. Mike Slater of Yates Petroleum, Artesia, N. Mex.; David Northrop of the Sandia National Laboratory of Albuquerque; and Mr. Derrick of the El Paso Natural Gas Co.

I would reiterate my request that you condense your testimony as much as possible. Without objection, your complete statements will be entered in the record.

I would ask that you proceed as you will.

STATEMENTS OF MIKE SLATER, YATES PETROLEUM, ARTESIA, N. MEX.; DAVID A. NORTHROP, SANDIA NATIONAL LABORATORY, ALBUQUERQUE, N. MEX.; AND A. M. DERRICK, EL PASO NATURAL GAS CO. OF EL PASO, TEX.

Mr. SLATER. Thank you for this opportunity to discuss unconventional gas technology. From an oil and gas producer's perspective,

unconventional gas resources generally fall into two main categories: tight gas reservoirs and deep gas reservoirs. The extent of our ability to tap these extensive resources is completely dependent on the refinement of current technology and the development of new technology in the areas of drilling, completion, and operating.

In New Mexico numerous tight gas reservoirs have been discovered by New Mexico gas producers and approved by the appropriate governmental agencies. A tight gas reservoir is defined by FERC as having permeability of 0.1 millidarcie or less. The cement floor in your basement or garage, has that permeability.

Most notable of these tight gas reservoirs here in the Roswell area is the Pecos Slope Abo located north of Roswell.

I would like to have chart 1 put up. This first chart shows a typical Abo log on the left. The colors in there illustrate the various lenticular fashions of this reservoir. It extends over about a 400-foot vertical stretch. These wells are about 4,000 feet deep. Fracturing has been the key to developing the tight gas reservoirs of the Pecos Slope Abo. Fracturing is a process which cracks the gas bearing rocks and allows the gas to flow into the wellbore.

What we have on chart 2 is the typical fracture. We have a wellbore, a steel pipe encased in cement. The blue is the Abo bearing rock which is tight and basically will not produce anything naturally. The red represents the wedge of sand that was driven hydraulically into the formation. As a result the gas can be produced because the sand wedge is much more permeable than the existing formation.

You will notice that we have a frac height "H," and a radius "R." Improvements in frac technology must be researched further to improve gas recovery.

I would like to share with you some of Yates' Petroleum's goals that we use toward this end. No. 1, frac height. We want the frac to cover the entire height of the pay, yet we do not want it to get outside of the pay. It might frac into water and you will have a water well instead of a gas well.

Probably one of the most important things is frac length. Again we can call that frac R. The longer the frac radius we have, the more the drainage radius and the more gas well recovery. I would like to show how technology, if it could increase frac length, could save a lot of money for the operators and also get the price of gas down. I think we are all interested in that.

On the left side is typical frac geometry for an Abo spacing unit. In the Abo we drill four wells per square mile or four wells per section. The red dots indicate the four wells we now drill per section. The blue squiggly lines indicate the frac length or perhaps the frac drainage area.

In any case, it takes four wells at about $300,000, these are wells without problems, so it would cost $1.2 million to develop an Abo section. If we improve frac technology perhaps we can only drill one well per section and by putting a massive frac of some sort on it drill one for $600,000.

It is obvious we will save if we can do this, save $600,000 a well. This allows us to spend money on other explorations and have an effect on the price of gas.

Another area we are working on is diverting agents. When Bob had the well log up there you noticed several lenticular sands. When we put a frac job on the well, we want each zone to get the proper frac, maybe benzoic acid or a rock salt. It is more art form than a science, and technology needs to be put into this.

Frac fluids, we want to improve our frac fluids, typically it is water or oil but in the Abo it is water. These fluids have to carry high concentrations of sand at low friction factors and be inexpensive. The last thing we are working on is evaluation tools. We want to have proper frac height and length, but we do not have the tools at this time to tell us that we have been successful.

It is important to keep in mind, however, that technology alone does not account for such development, but rather technology coupled with economics. Much of the tight gas produced today can be developed only as a result of higher prices for gas. Without these higher prices, much of this production might not be available due to unfavorable economics.

I have another chart on the back of one of those I would like to show.

This is something we are all interested in both nationally and here in New Mexico. The topograph shows the monthly drilling rig count for the United States over the last year-and-a-half. You can see in early January of 1981 the rig count for the United States, the red line started to decline and it peaked at an all time total of a little over 4,500 rigs in January of 1982.

And then because of price decreases in both crude and natural gas, the rig count dropped now to about 2,700 or 2,900 rigs. On the bottom is the drilling rig count for the Chaves County area. We start out at the same time low in early January but the yellow line is when the tight gas pricing went into effect.

Prior to this time Abo gas was selling for $2.50 an Mcf in round numbers. Half the yellow line production was $5 an Mcf. You can see that drilling took off and skyrocketed in the Abo country. Then it sort of peaked in January and has since tumbled all because the price of gas has gone down. You cannot drill the Abo wells for $2.50 an Mcf nor can you handle the risk, but at $5 it makes it more attractive.

I would like to touch briefly on deep gas technology since that is the other part of the ball game. We generally mean wells deeper than 15,000 to approximately 25,000 feet. These wells provide a tremendous challenge and operators drilling these 25,000-foot wells are operating on the ragged edge of technology as is evidenced by the large number of junked holes or those producing with mechanical problems.

Again, because of the high costs, gas pricing must be such as to cover costs and provide an acceptable return. Technology is working on these problems by developing such specialized tools as downhole drilling motors, drilling fluids, which can handle the high temperature, special high strength pipe and of course, training of personnel skilled in these deep wells, through the use of simulators.

In summary, the continued development of technology is the name of the game if we are to have adequate and economic supplies of gas.

Thank you.

[The prepared statement of Mike Slater follows:]

PREPARED STATEMENT OF MIKE SLATER

1. To what extent will our ability to tap these large sources of natural gas depend on the development of new technology?

From an oil and gas producer's perspective unconventional gas resources generally fall into two main categories; "tight gas" reservoirs and "deep gas" reservoirs. The extent of our ability to tap these extensive resources is completely dependent on the refinement of current technology and the development on new technology in the areas of drilling, completion and operating.

In New Mexico numerous tight gas reservoirs have been discovered by New Mexico gas producers and approved by the appropriate governmental agencies. A tight gas reservoir is defined by FERC as having permeability of .1 millidarcie or less. The cement floor in your basement or garage, has that permeability. Most notable of these "tight gas" reservoirs here in the Roswell area is the Pecos Slope Abo located north of Roswell. Fracturing was the key to developing the "tight gas" reservoirs of the Pecos Slope Abo. Fracturing is a process which cracks the gas bearings rocks and allows the gas to flow into the wellbore. However, it is important to keep in mind that technology alone does not account for such development, but rather technology coupled with economics. Much of the tight gas produced today can be developed only as a result of higher prices for gas in this category. Without these higher prices much of this production might not be available due to unfavorable economics. This is to say that mechanically the gas could be produced, but probably at a financial loss. Accordingly, if higher prices are not available, continued development of "tight gas" reservoirs would continue only if refinement of existing technology provides a more economical means of drilling and completing "tight gas" wells.

"Deep gas" development (15,000 to 25,000') also provides a challenge to the petroleum industry. Operators drilling these 25,000' wells are operating on the ragged edge of technology as is evidenced by the large number of junked holes or those producing with mechanical problems. Again, because of the high costs, gas pricing must be such as to cover costs and provide an acceptable return. Technology is working on these problems by developing such specialized tools as downhole drilling motors, drilling fluids, which can handle the high temperature, special high strength pipe and of course, training of personnel skilled in these deep wells.

In summary, the continued development of technology is the "name of the game" if we are to have adequate and economical supplies of gas.

2. How does the current financial and institutional status of the gas production and transmission industry affect their ability and willingness to develop and use new technologies?

The gas production industry is today faced with a dilemma due to current and proposed price changes affecting the price of gas, i.e. the amount of drilling is directly tied to the price of gas. Since 1975 independents have spent over 105 percent of their wellhead earnings on additional drilling. More important, API figures show that gas well completions are a function of wellhead price. U.S. gas completions rose to 17,894 in 1981 from 13,064 in 1978. The increase was in response to the average wellhead price that rose from 91¢/mcf in 1978 to $2.38 in 1981. If the U.S. is to be gas self-sufficient, realistic pricing must be in place. The gas industry can only employ and develop new technologies when a good possibility exists that such would be economical. The development of heretofore uneconomical properties such as tight or deep gas generally involves new expensive technology. This generally requires higher price gas to privde an adequate return on investment. We are currently faced with a short-term natural gas surplus that many experts agree will develop into a shortage in the coming years. We may then be forced to rely further on unstable foreign markets to ease the shortages unless action is taken now to expand our natural gas reserves. Many marginal properties have been developed in our part of the country recently and the development was predicated on the increased gas prices allowed under the NGPA of 1978. This development has greatly slowed in the past few months to the decreased demand for natural gas at the maximum allowable prices allowed under the NGPA.

MIKE SLATER

Mike Slater is Operations Manager for Yates Petroleum Corporation located in Artesia, New Mexico. Yates is one of New Mexico's most active oil and gas operators. He was previously employed by Amoco Production Company (A subsidiary of Standard Oil of Indiana) and Mesa Petroleum. He earned his engineering degree at Missouri School of Mines and Metallurgy.

Mr. SENSENBRENNER. Thank you, Mr. Slater.

Mr. Northrop.

Mr. NORTHROP. My remarks are closely aligned to those of the first panel. My thesis is the tight gas reservoirs represent a significant national energy resource. One whose ultimate use will depend upon long-range, high-risk R&D activities, many of which are currently being pursued in the Department of Energy's western gas sands project.

The tight gas resource is large. The recent National Petroleum Council study of these reservoirs identified a resource of 924 trillion cubic feet, two-thirds of which may be ultimately recoverable. This is to be compared with the current national consumption of nearly 20 trillion cubic feet per year.

As others have said, there are two types of tight gas reservoirs. Blanket reservoirs consist of continuous sands with relatively constant properties. Such reservoirs lend themselves to empirical trial and error development through the extension of current technology. Some 5 percent of current gas supplies comes from this type of reservoir.

Lenticular reservoirs, on the other hand, consist of discontinuous, low permeability, sand bodies of varied geometry, size, and properties. The advanced, new technology will be required to recover gas from these reservoirs. There is essentially no commercial production, and industry R&D does not address this resource specifically.

But it is the lenticular reservoirs which represent a significant portion of the tight gas resource, especially in the Rocky Mountain States. The NPC study estimated that four western basins contain approximately 240 trillion cubic feet of gas, of which 88 percent is found in lenticular sands. The several years' supply of natural gas is a worthy target for R&D.

The approach to recover this gas is currently controversial. One side says the marketplace will dictate supply and that with decontrol industry will perform the R&D. On the other hand, the long-range, high-risk R&D requirements argue for a legitimate Federal role. I believe both approaches are necessary as evidenced by the following two arguments.

First, the NPC study, determined the amount of gas that would be recovered from all tight gas reservoirs under different price and technology scenarios. Essentially, the bottom line of their analysis is that R&D is as important as price in developing the tight gas resource.

Second, I hold that a complementary relationship exists between industry and Government R&D. The thrust of industry-sponsored R&D is to maximize the rate of return upon investment. For example, price decontrol will increase production from conventional or the best and easiest of the unconventional reservoirs. On the other hand, the thrust of Government-sponsored R&D should be to maximize the availability of the resource and to insure that it is recovered efficiently. Thus, these two thrusts are not the same as is often assumed with the result being in the overall national interest.

The R&D program necessary to achieve the advanced technology case was described in detail in the NPC study. The program was

adopted, essentially without change, from the Department of Energy's R&D management plan for the tight gas reservoirs which guides the ongoing DOE western gas sands project.

The required R&D program must focus upon two needs: One, to characterize the lenticular, tight gas resource, and two, to improve the technology to recover it.

Time does not permit full discussion of the varied activities required to satisfy these needs. Activities underway include: Advanced logging research, in situ stress measurement, geologic studies on both micro and macro scales, geophysical techniques, to map lenticular sand bodies, improved hydraulic fracture fluids, proppants, models, and mapping techniques.

There are two activities I would like to touch on since they are excellent examples of the appropriate, federally supported R&D in this area.

First, is the in situ fracturing experiments conducted at an existing tunnel complex at DOE's Nevada test site where mineback allows for direct observation of fracture behavior. This unique activity has provided significant insight into the fracturing process. Results include determining the role of in situ stresses in controlling fracture geometry, the first measurement of fracture widths during fracturing, the effects of well casing perforations, and development of a novel technique for creating multiple radial fractures from a wellbore.

A second major current activity is the multiwell experiment referred to earlier. This is a research oriented field laboratory being conducted by Sandia National Laboratories for the DOE. The nature of previous field tests provided insufficient data to answer crucial questions about the factors which limit production in the lenticular tight gas sands.

In the multiwell experiment the unprecedented scope of activities and results from the R&D program will be combined. Hopefully, enough of the pieces will be available to solve the lenticular tight gas sand puzzle.

One unique feature is the close well spacing of 135 feet. All industry tests have been on commercial well spacings of more than a half mile which is greater than the dimensions of the sand bodies themselves. Such close spacing is uneconomic but is vitally necessary for the required R&D. The close spacing allows quantifying of geologic and reservoir properties and their variations, interference testing between wells, well-to-well geophysical profiling, detailed measurements of in sutu stress and fracture diagnostics.

To date, two wells 8,300 feet deep have been drilled in the Piceance Basin at a site near Rifle, Colo. Here the Mesa Verde, the formation of interest, lies at a depth between 3,900 and 8,300 feet. The preliminary core, log, well and seismic data have provided an initial characterization of the site. Four years of stimulation experiments over this interval have been defined with the first to occur in November 1982. The recent overview paper, submitted as exhibit A in my written testimony, presents the objectives, rationale, and current status of that experiment.

The close relationship must exist between this Government R&D and industry. The NPC proposed R&D effort is ample evidence of industry's endorsement of the current DOE program. However,

other examples of viable technology transfer exist. First, there is a seven-member technical review panel from industry which provides guidance to the multiwell experiment. This has led to direct interaction with their companies in the areas of logging, core analysis, in situ stress, and hydraulic fracture stimulation design.

Interaction occurs through meetings and publications of the Society of Petroleum Engineers. One example is the 1981 SPE symposium on low permeability reservoirs attended by over 1,000 people where approximately half of the 60 papers resulted from DOE-sponsored research.

DOE-sponsored workshops on specific topics have been held. These include one for logging research in Tulsa and timely displays of multiwell experiment core and results in Grand Junction, Colo.

DOE also sponsors research at universities with active petroleum departments; these include New Mexico Tech, Tulsa, Oral Roberts, University of Oklahoma, Texas A&M, and Stanford.

DOE's western gas sands project results are reported quarterly to a mailing list of over 500 and copies of all reports are available through the National Technical Information Service.

Lastly, commercial services are now available for hydraulic fracture mapping, improved pressure coring techniques, and polycrystalline diamond drill bit technology. These were all once DOE R&D activities.

In summary, I wish to restate these major points. First, a significant, tens-of-years supply of natural gas is available in the tight gas reservoirs.

Second, their production will require advanced technology from an aggressive R&D program, one which is appropriate for Federal support due to its long-term high risk nature.

Three, the DOE R&D program already exists which addresses the key needs of characterizing the resource and developing the improved technology for its production.

Four, the multi-well experiment has just begun. It is a unique field laboratory for tight sands research.

Five, an effective technology transfer mechanism exists.

Finally, development of this resource is in this Nation's interest. It represents an environmentally attractive, efficient energy source, with an established distribution network and reduces our dependence on foreign energy by unlocking a significant new energy resource.

I thank you very much for your careful consideration of this important and timely topic.

[The prepared statement of David A. Northrop follows:]

TESTIMONY OF DR. DAVID A. NORTHROP, SANDIA NATIONAL LABORATORIES, BEFORE THE ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE OF THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY, JULY 30, 1982, ROSWELL, N. MEX.

First, the NPC study, determined the amount of gas that would be recovered from all tight gas reservoirs under different price and technology scenarios. According to their analysis, 192 tcf will be produced over the next 25 years under current (or base) technology and a gas price of $2.50 (in constant 1979 dollars) per thousand cubic feet (Mcf). Increasing the price to $5.00 or $9.00 per Mcf raises the cumulative produced gas to 365 and 404 tcf, respectively. However, with advanced technology, the result of an aggressive and far-sighted R&D effort, the amount of gas at $2.50 per Mcf becomes 331 tcf and the amounts at $5.00 and $9.00 per Mcf become 503 and 574 tcf, respectively. Thus, it is clear from these figures that R&D is as important as price in developing the tight gas resource.

Second a complementary relationship exists between industry and government R&D; this is shown in Figure 1. The thrust of industry-sponsored R&D is to pull this curve upwards, to maximize the rate of return upon investment. For example, price decontrol will increase production from conventional or the best and easiest of the unconventional reservoirs since industry will use current technology, or evolved extensions of it, to achieve the maximum near-term return. On the other hand, the thrust of government sponsored R&D should be to maximize the availability of the resource and to insure that the resource is not wasted and that it is recovered efficiently. It is clear that these two thrusts are orthogonal and in that the resultant is in the overall national interest. The two thrusts are not parallel as is often assumed; one does not substitute for the other in that they ~~have inherently different objectives~~ are. (1)

R&D Needs and Accomplishments

The R&D program necessary to achieve the advanced technology case was described in detail in the NPC study. The program was adopted, essentially in toto, from the Department of Energy's R&D management plan for the tight gas reservoirs which guides the ongoing DOE Western Gas Sands Project.

The required R&D program must focus upon two needs: (1) to characterize the lenticular, tight gas resource, and (2) to improve the technology to recover it. Each of these needs is further described by the objectives, and addressed by the activities, given in Figures 2 and 3.

DOE-sponsored R&D activities have been under way in each of these areas. Time does not permit full discussion of the results and impact of this work, but several highlights can be presented.

(1) Advanced logging research has produced an improved neutron log interpretation method for determining water and gas saturations in tight reservoirs.

(2) Program results have shown that in situ stresses are the predominant influence on hydraulic fracture orientation and geometry. Techniques for measuring in situ stresses (small hydraulic fractures, sonic logs, and analytical calculations) in layered formations have been developed and are being used.

(3) Microscopic examinations of the rock have provided insight into the paths which the gas must travel, paths which are affected by clays, water content, and small tight pores. On a larger scale, the extent of lenticular formations has been determined by constructing stratigraphic sections across priority regions, and the distribution and shapes of individual sands have been determined by field investigations at outcrops.

(4) The feasibility of mapping of sandstone channels at shallow depths by high resolution seismic reflection surveys has been demonstrated; extension to greater depths is under way.

(5) In situ fracturing experiments have been conducted in a tunnel at DOE's Nevada Test Site, where mineback allows for direct observation of fracture behavior. This unique activity has provided significant information on the role of in situ stresses in controlling fracture geometry; the first measurement of fracture width and pressure distributions; development of in situ stress measurement techniques; the effects of well casing perforations on fractures; and development of a novel technique for creating multiple, radial fracturing in a wellbore. (This activity represents a prime example of an appropriate role for federally-supported R&D and the use of existing federal facilities in such an effort.)

(6) Improved models for hydraulic fracture stimulation design and reservoir simulation have been developed based on the results from field tests, mineback and laboratory work. Improved fracture fluids and proppants are being developed based upon detailed study of their interaction with reservoir rock.

(7) Techniques have been developed to map hydraulic fractures. Tiltmeter (for fracture azimuth, symmetry, and length) and borehole seismic (for fracture azimuth and height) techniques are available now as commercial services.

(8) A research-oriented field laboratory in a lenticular tight gas reservoir has been established: the Multi-Well Experiment, to be described in the following section.

It must be mentioned that most of these accomplishments can be applied to other unconventional gas sources such as Devonian shale and coal-bed methane.

The Multi-Well Experiment

The Multi-Well Experiment (MWX) is a research-oriented field laboratory being conducted by Sandia National Laboratories for DOE. Its objective is developing the understanding and the technology necessary to allow future production from lenticular tight gas sands. The nature of previous field tests provided insufficient data to answer the crucial questions which limit production. At the same time, results from the R&D program can now be applied, thus resulting in an unprecedented scope of activities aimed at this resource.

The key to MWX is the synergism resulting from a broad spectrum of activities. This is shown in Figure 4, where the results from the various activities will define both the reservoir and the hydraulic fracture. These, in turn, define the net pay stimulated: the intersection of a hydraulic fracture of known geometry with a reservoir of known morphology and properties. In current commercial tight gas sand practice, of the nine activities listed, only logs (of questionable accuracy), well tests, empirical stimulation design, and reservoir analyses are used, resulting in an underdetermined problem.

The synergism is enhanced by the close well spacing in MWX. This close spacing is unique; all industry tests have been on commercial well spacings of greater than 0.5 mile which is greater than the dimensions of the lenticular sand bodies. Such close spacing is uneconomic, but it is vitally necessary for the required R&D. The close-spaced wells allow for quantifying the geologic and reservoir properties and their variation, interference testing for in situ measurement of permeability and porosity, well-to-well geophysical profiling, detailed measurements of in situ stress in the sand and surrounding shales, and downhole fracture diagnostics during stimulation.

To date, two 8350 ft wells (a third is sought), 135 ft apart, have been drilled in the Piceance Basin at a site near Rifle, Colorado, where the Mesaverde, the formation of interest, lies at a depth of 3900-8300 ft. Preliminary core, log, well, and seismic data have provided an initial characterization of the site. Four years of stimulation experiments over this interval have been

defined with the first to occur in November, 1982. A recent overview paper, submitted as Exhibit A, presents the objectives, rationale, approach, and current status of the experiment.

Technology Transfer

Implicit in Figure 1 is that a close relationship must exist between industry and government R&D. The NPC proposed R&D effort is ample evidence of industry's awareness of the current DOE program activities and its endorsement of them. However, far more evidence exists for a viable industry-government interaction.

(1) A seven-member Technical Review Panel, representing companies with tight gas sands interests, provides guidance in the planning and execution of the Multi-Well Experiment. There have been direct interactions with these companies in the areas of logging, core analysis, in situ stress measurements, and stimulation design.

(2) Interaction occurs through the Society of Petroleum Engineers. Recent articles in the Journal of Petroleum Technology and Society of Petroleum Engineers Journal have presented the results of DOE research efforts. At the 1981 SPE/DOE symposium on Low Permeability Reservoirs (attended by over a thousand people), approximately half of the sixty papers resulted from DOE-sponsored research. A special session on MWX has been proposed for the March 1983 meeting. A tour for industry of the mineback experiments at the Nevada Test Site was conducted in conjunction with the annual SPE meeting in 1979.

(3) DOE-sponsored workshops on specific topics have been held; these include one for logging research in Tulsa, OK, and timely displays of MWX core and results in Grand Junction, Colorado.

(4) News releases and personal contacts have resulted in articles in the various trade magazines. Recently, the Oil and Gas Journal had a lead article on tight gas reservoirs which featured MWX on the cover photo and in the text.

(5) DOE also sponsors research at universities with active petroleum departments; these include New Mexico Institute of Mining and Technology, Tulsa University, Oral Roberts University, the University of Oklahoma, Texas A&M University and Stanford University.

(6) DOE's Western Gas Sands Project results are reported quarterly to a mailing list of over 500, and copies of all reports are also available through the National Technical Information Service.

(7) Technology has been transfered directly from DOE's program. Commercial services are now available for tiltmeter and borehole seismic methods for fracture characterization, improved pressure coring techniques, and polycrystalline diamond drill bit technology.

Summary

In summary, I wish to present the major points from each of the previous sections:

(1) A significant, tens-of-years supply of natural gas is potentially available in the tight gas reservoirs.

(2) Production will require advanced technology which must result from an aggressive R&D program, one which is appropriate for federal support due to its long-term, high-risk nature and which will not be pursued by industry on its own.

(3) A DOE R&D program exists which addresses the key needs of characterizing the resource and developing improved technology for its production.

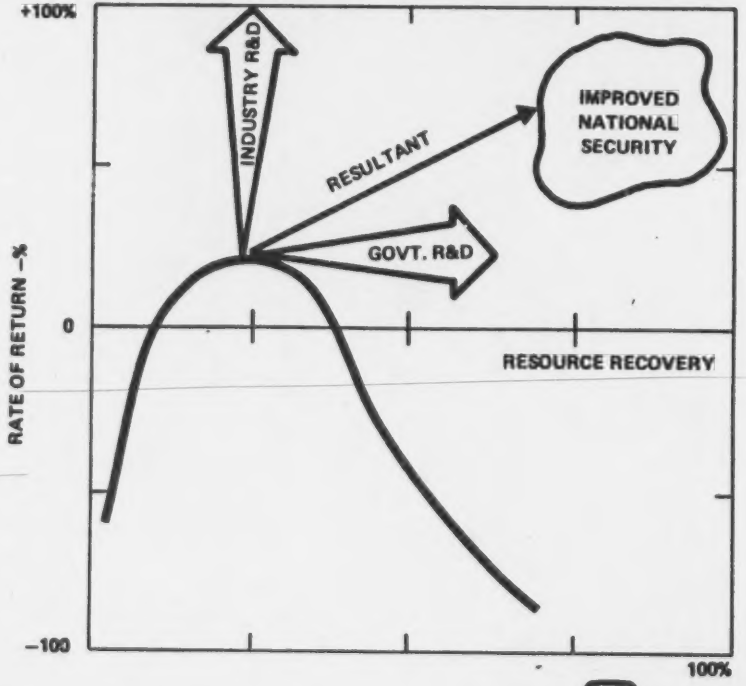
(4) The Multi-Well Experiment, a unique field laboratory for tight gas sands research, has just begun; it will utilize the results of the R&D program as well as define the critical constraints upon development of this resource.

(5) An effective technology transfer mechanism is in place and is working.

Finally, development of the tight gas sand unconventional gas resource is consistent with the objectives of the present administration. It will create jobs and investment opportunities and will spur economic growth. It represents an environmentally attractive, efficient energy source with an established distribution network. And it reduces our dependence on foreign energy by unlocking a significant new energy resource.

Thank you very much for your careful consideration of this important issue.

THE COMPLEMENTARY RELATIONSHIP BETWEEN INDUSTRY AND GOVERNMENT R&D



Sandia National Laboratories

FIGURE 2

CHARACTERIZE THE RESOURCE

- OBJECTIVES
  - DETERMINE RESERVOIR PROPERTIES AND THEIR VARIABILITY
    - MEASURE PERMEABILITY, POROSITY, WATER AND GAS SATURATIONS, ETC.
    - DETERMINE IN SITU EARTH STRESSES
  - DEFINE GEOMETRY AND SPACIAL DISTRIBUTION OF RESERVOIRS
    - UNDERSTAND GEOLOGIC PHENOMENA WHICH FORMED RESERVOIR ROCK
    - DETERMINE GAS ORIGIN AND MIGRATION
    - MEASURE ORIENTATION AND MORPHOLOGY OF LENTICULAR SANDS
- ACTIVITIES
  - ADVANCED LOGGING TECHNOLOGY
  - WELLBORE MEASUREMENT OF IN SITU STRESS
  - GEOLOGIC MODELS AND CRITERIA FOR GAS PRODUCTION
  - ADVANCED GEOPHYSICAL SURVEY TECHNIQUES

FIGURE 3

IMPROVE RECOVERY TECHNOLOGY

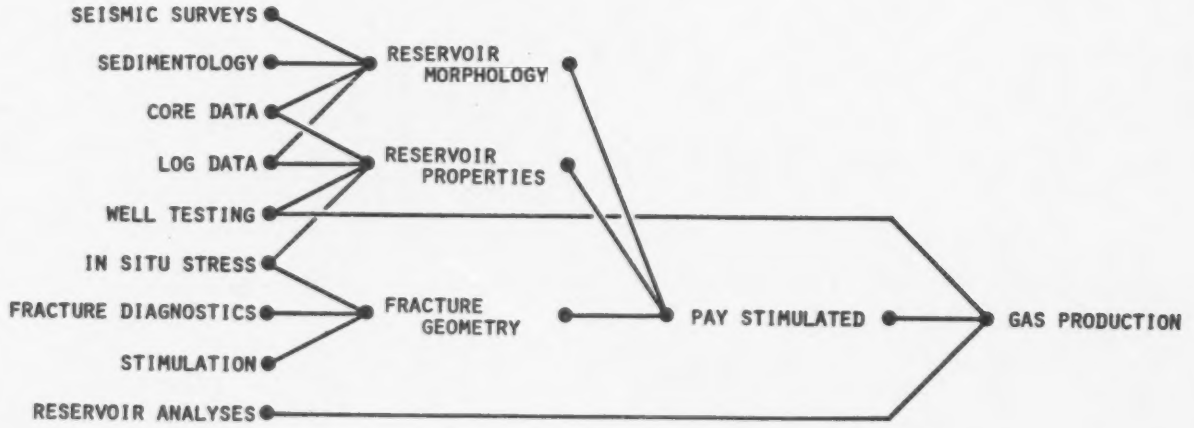
- OBJECTIVES
  - DETERMINE PARAMETERS AFFECTING GAS PRODUCTION FROM TIGHT RESERVOIRS
  - OPTIMIZE STIMULATION FOR GIVEN SITE AND INTERVAL
    - PREDICT FRACTURE GEOMETRY AND ORIENTATION
    - REDUCE RESERVOIR DAMAGE FROM DRILLING AND STIMULATION
    - IMPROVE EFFECTIVE FRACTURE AREA AND CONDUCTIVITY
  - DEVELOP FRACTURE MAPPING TECHNIQUES
  - DEVELOP NOVEL STIMULATION TECHNIQUES
- ACTIVITIES
  - MINEBACK EXPERIMENTS FOR FRACTURE OBSERVATION
  - IMPROVED FRACTURE AND RESERVOIR MODELS FOR STIMULATION DESIGN
  - IMPROVED FLUIDS, PROPPANTS AND COMPLETION TECHNIQUES
  - FRACTURE DIAGNOSTIC TECHNIQUES
  - RESEARCH-ORENTED FIELD TESTS, THE MULTI-WELL EXPERIMENT

Sandia National Laboratories

99-979 O - 82 - 5

FIGURE 4

SYNERGISM IN MWX ACTIVITIES



Sandia National Laboratories

EXHIBIT A

THE MULTI-WELL EXPERIMENT: A FIELD LABORATORY FOR TIGHT GAS SANDS RESEARCH*

David A. Northrop and Allan R. Sattler

Sandia National Laboratories, Albuquerque, NM 87185

ABSTRACT

The Multi-Well Experiment (MWX) is a research-oriented field laboratory whose objective is developing the understanding and technology to allow economic production of the over 200 trillion cubic feet of natural gas estimated to lie within the low permeability, lenticular gas sands in the western United States. Experiment activities include: (a) close-spaced (100-200 ft) wells, (b) comprehensive core and logging programs, c) extensive in situ stress measurements, (d) geophysical surveys to determine sand body configurations, e) diagnostic measurements for hydraulic fracture characterization, and (f) a series of stimulation experiments. Analysis of data from these activities will yield improved geologic, reservoir, and stimulation models and improved log interpretation methods for lenticular, tight gas sands.

To date, two 8350 ft wells, 135 ft apart, have been drilled in the Piceance Basin at a site near Rifle, Colorado, where the Mesaverde, the formation of interest, lies at a depth of 3900-8300 ft. Preliminary core, log, and well data have provided an initial characterization of the site. Four years of stimulation experiments are planned for this field laboratory.

INTRODUCTION

New and improved technology is required to enhance gas production from the low permeability reservoirs of the United States. These reservoirs constitute a major target for new and supplemental supplies of natural gas. The National Petroleum Council's recent study estimates a maximum recoverable resource of over 600 TCF.[1] This gas is found in two broad categories of formations: continuous, blanket sands and discontinuous, lenticular sands. The latter are reservoirs characterized by lenses of low permeability sand of limited, variable lateral extent and thickness enclosed in a matrix of shale and silty shale. As seen in Table I, most of the gas sands in four Rocky Mountain basins are lenticular. This several years supply of natural gas is the target for the Multi-Well Experiment.

The United States government's efforts to stimulate natural gas production from these reservoirs began in the mid-1960s. The early work evaluated the use of nuclear explosives for fracturing, but this technique was abandoned in 1973. Since that time, efforts have focused upon massive hydraulic fracturing and a total of nine government-industry, cost-shared field projects have been conducted. These were generally designed to be demonstrations of the current industry fracturing technology as applied to these lenticular formations. The results were disappointing and did not yield either an improved technology or commercial production of this resource.

The basic problem is that the past field tests provide insufficient data to define the critical factors affecting gas production from lenticular sands. To illustrate this point, Table II presents results from a previous government-industry field experiment in the lenticular sands. Shown are four different intervals that were fractured at different depths in a given well. Note the difference between the designed fracture length and the observed fracture length, where the latter was calculated from a type curve match to production. More striking perhaps is the lack of substantial improvement in gas flow after stimulation.

The reason for these disappointing, noneconomic results cannot be explained since this is an undetermined problem, as only gas production and logs are available for analysis. These data cannot uniquely define the reason from among the following: (a) current logs and analyses cannot identify accurately gas-bearing sands and gas-in-place, (b) the sand lenses are smaller than believed, (c) hydraulic fractures do not remain in the pay sand and are not able to penetrate sands not in contact with the wellbore, or (d) hydraulic fractures penetrate remote sands, but the intervening shales cannot be propped.

In addition, the overall characteristics of these field tests were not conducive to obtaining the needed information. The tests were cost-shared with industry, which resulted in production-oriented plans, schedules and budgets. The well spacings were greater than a mile, and this is greater than the lens dimensions. No core was available from any of the intervals that were fractured. Finally, limited, if any, diagnostic instrumentation were used to characterize hydraulic fracture behavior.

The intent of the Multi-Well Experiment is

*This work supported by the United States Department of Energy.

Prepared for the 17th Intersociety Energy Conversion Engineering Conference, August 1982, Los Angeles CA.

to reverse these characteristics and provide a situation where uncertainties surrounding this resource can be resolved.

THE MULTI-WELL EXPERIMENT

The Multi-Well Experiment is a research-oriented field laboratory with the overall objective to determine the viability of the lenticular tight gas resource. This will be accomplished by a comprehensive geologic characterization of these gas sands and the evaluation of state-of-the-art and developing technology for their production.

Specific objectives for the Multi-Well Experiment are:

1) to determine the size, shape, orientation, and distribution of lenticular sands;

2) to determine in situ reservoir properties and quantify their variations within a lens and between lenses;

3) to improve reliability and accuracy of log interpretation in tight gas sands;

4) to determine the effects of earth stresses upon stimulation and gas production;

5) to conduct stimulation experiments to evaluate technology and answer key questions concerning production; and

6) to perform analyses and evaluations to assess the viability of gas production from lenticular tight gas reservoirs.

The concept of the Multi-Well Experiment is shown in Figure 1. The key feature is the three close-spaced wells. The 100- to 200-ft spacing of these wells is less than the nominal dimensions of the lenses in the area. Core, log, well-testing, and well-to-well seismic data will allow a far better definition of the geological setting than has been available previously. Extensive core will be taken from each well through the 4000 ft thick Mesaverde formation. Comprehensive logging and core analysis programs will be conducted. The close-spaced wells also allow well-to-well interference testing to obtain an accurate value of the in situ permeability and porosity. One of the wells is designated as the stress well and will be used to determine the variation of in situ stress throughout the interval of interest. This stress well is one facet of a comprehensive effort to address the effect of earth stresses upon gas stimulation and production. Two of the wells will be used as observation wells during stimulation in the third well.

A series of stimulation experiments have been defined and will be finalized once the log, core, well test and seismic data characterizing the site have been analyzed. There will be an individual plan for each experiment which will define the objectives and the well testing, diagnostics, and analyses required. Specific objectives for the stimulation experiments include:

1) to determine hydraulic fracture geometry in relation to lens orientation and extent in order to separate factors affecting gas production;

2) to determine if lenses not in contact with the wellbore can be intersected and produced;

3) to determine if a series of lenses in contact with the wellbore can be efficiently produced;

4) to evaluate geologic/reservoir factors (e.g., water saturation, earth stress, rock type, etc.);

5) to evaluate stimulation factors (e.g., fluid type, proppant type or concentration, fracturing rate, etc.); and

6) to evaluate new stimulation techniques, as available.

The key to achieving the various Multi-Well Experiment goals is the synergism resulting from a broad spectrum of activities. This synergism is shown schematically in Figure 2, where the results from the various activities will define the reservoir and the hydraulic fracture. These, in turn, define the net pay stimulated: the intersection of a hydraulic fracture of known geometry with a reservoir of known morphology and properties. These definitions are further enhanced by the fact that most data will come from close-spaced wells. Thus, spatial variations in reservoir properties can be quantified.

Significant advances in the different models required to assess tight gas production will be possible. These models include: (a) a geologic model based upon site-specific information (cores, logs, seismic data, stress, production, etc.) combined with other regional data to yield a sedimentological basin model for the lenticular sands of the Upper Cretaceous in the Piceance Basin; (b) a reservoir model for lenticular sands based on single well and well-to-well testing, core data, logs, and analyses; (c) improved log interpretation models through quantitative core property-log correlations and measurement of accurate in situ reservoir properties from well testing, pressure coring, and core property measurements under restored state conditions; (d) modified fracture and stimulation models based upon the improved in situ stress, fracture diagnostic, and production test data which will be available; and (e) an overall systems model for tight gas sands production.

The latter model consists of three major parts: geologic/reservoir, stimulation, and economic. The first yields an estimate of gas in place (the target), the second gives gas produced as a function of time (that recoverable), and the third calculates the dollars obtained (the return on investment). Current data and assumptions can be used and parametric studies run to determine quantitatively the critical parameters affecting production and economics. As MWX results, analyses, and improved models become

available, they can be included and periodic updates obtained. Finally, improved estimates will be made of the amount of recoverable gas.

Clearly, the Multi-Well Experiment is a research-oriented field laboratory. Its activities will provide many more pieces of the tight gas sands puzzle than previously available. Hopefully, enough pieces will be fitted together so that an overall solution, production from this unconventional gas resource, is possible.

THE MWX SITE

Criteria for site selection were: (a) a sequence of lenticular sands representative of those which contain the bulk of the tight sand resource; (b) a blanket sand section so that a comparison can be made of stimulation results; (c) sufficient geological control for assurance of productivity; (d) both water-productive and gas-productive sands to compare log responses in each; (e) a site close to a road, pipeline, and electric power and at an elevation to allow year-around operations; and (f) a site to be made available to the government for the estimated 5-year term of the experiment.

Such a site was found in the Rulison Field in the Piceance Basin of Colorado. It is located in Section 34, Township 6S, Range 94W, Garfield County, Colorado; this is 7 miles west of Rifle and a quarter mile south of the Colorado River. The Superior Oil Company assigned the tract to CER Corporation, who, under contract to Sandia National Laboratories, will be the operator during the life of the project, after which Superior will resume operations.

The stratigraphy of the MWX site is shown in Figure 3. The formation of interest, the Mesaverde, lies approximately between 3900 and 8300 ft. The fluvial, lenticular sands comprise most of this interval and these grade into the more carbonaceous, but gas-bearing, paludal deposits. Three continuous, blanket sandstones are at the base of the column; the Corcette and Corcoran sands are gasbearing, while the Rollins is water saturated. The fluvial sediments are gas-bearing below approximately 5000 ft.

This stratigraphic column is exposed in outcrop at Rifle Gap in the Grand Hogback, approximately 11 miles northeast of the MWX site. The south end of the gap is at the Wasatch-Mesaverde contact, with the north end opening into the Rifle Gap Reservoir which fills the depression formed by erosion of the Mancos shale. The sandstones stand out clearly on outcrop and allow sedimentological studies to be performed. The depositional models from that study will provide guidance in the interpretation of MWX data. The fluvial sands were deposited as laterally migrating point bars resulting in irregularly oriented and shaped sand bodies. Meander belt horizons with relatively higher sandstone fractions are observed in both Rifle Gap and MWX data. Thus, Rifle Gap provides excellent insight into the geology at the MWX site.

MWX RESULTS

Two 8350 ft wells, spaced 135 ft apart, have been completed at the MWX site between September 1981 and March 1982. In both wells, a 13-3/4 in. surface hole was drilled with a low-solids, non-dispersed water-based mud system to approximately 4100 ft, and 10-3/4 in. casing was set and cemented. The mud was then converted to a 90:10 oil-based emulsion mud system which was selected to improve hole stability and core recovery and quality. The wells were then drilled and selected intervals cored with 8-3/4 in. bits. Significant gas shows were encountered throughout the section and mud weights from 10 to nearly 15 lbs/gal were required from 5000-8000 ft. Both wells were completed with the setting and cementing of 7 in. casing.

Figure 3 also presents an overview of coring and logging activities on the two wells. A total of over 3700 ft of 4 in. diameter core was cut with a recovery of better than 99%: 2744 and 930 ft in MWX-1 and MWX-2, respectively. Logging programs were run to 4100 ft, through the fluvial sections to 6700 ft, and over the entire Mesaverde. Sands of varying thicknesses and qualities account for approximately 18 percent of the fluvial section. Preliminary, routine core analyses on plugs show sandstone porosities of 5-10 percent, permeabilities of 1-100 microdarcies, and water saturations of 30%-90%.

A comparison of logs run over the same interval in the two wells is shown in Figure 4. This is offered without explanation at this time, but sand continuity as well as changes are seen in this example. These are unique, important data.

A considerable degree of natural fracturing was observed; over 350 such fractures were measured in MWX-1 core. Two distinct styles of fracturing are evident and are clearly associated with different lithologies. The natural fractures observed in sandstones are essentially vertical with no indication of shear motion. They always contained calcite, which usually only partially fills the fracture, and their widths ranged from 1/32 to 3/4 in. A total of 22 such fractures were found in MWX-1 core, all below 5000 ft and with the greatest number between 5700 to 6100 ft. In one 50-ft MWX-2 interval around 5725 ft, such fractures were found in each of four sands, implying a fracture spacing over this interval of less than the 4-in core diameter. Significant gas shows are associated with these open fractures. These vertical fractures were not observed to extend into the surrounding shales; a fracture that reached a shale-sandstone interface always terminated abruptly at the interface. In contrast, fractures in the confining mudstones or shales are characterized by low angle dips (~ 50°) and slickensides indicating dip-slip motion. Mineralization of these shear fractures was never observed. Over 330 such fractures were measured in MWX-1 core, and it is believed that many more hairline fractures of this type are also present.

MWX FUTURE ACTIVITIES

Four years of stimulation experiments have been designed which address the goals given in a previous section. However, interval selection and stimulation program definition will require the results from ongoing core and log analyses as well as well test, in situ stress, and seismic data to be collected at the site during the coming summer. The first stimulation is currently planned for November 1982.

CONCLUSIONS

(1) The Multi-Well Experiment is a unique research-oriented field laboratory whose unprecedented range of activities will answer key questions about the viability of, and production from, the lenticular, tight gas sand unconventional gas resource.

(2) Two 8350 ft deep wells have been completed at a site in the Piceance Basin near Rifle, Colorado. Approximately 3700 ft of core were taken and comprehensive logging programs run. Significant gas shows were observed. A suitable field laboratory has been established.

(3) Two significant findings have been noted to date. First, logs from both wells have given the first insight into the continuity and variability of lenticular sands over short, 100 ft distances. Second, numerous open mineralized fractures were found in sandstone core in similar depths in each well, and these were associated with significant gas shows in each case. Thus, the importance of natural fractures in tight gas production must be emphasized.

ACKNOWLEDGMENTS

MWX is the major field project in the United States Department of Energy's Western Gas Sands Project which is managed by D. C. Ward and A. B. Crawley at the Bartlesville Energy Technology Center. C. H. Atkinson of that organization is technical project officer for MWX. R. L. Mann and other personnel of CER Corporation, Las Vegas, Nevada, provide excellent field engineering and other technical support for MWX. A technical review panel from industry has contributed significantly in the planning and several field activities. Final thanks are given to the many Sandia personnel who have participated in the Multi-Well Experiment.

REFERENCES

1. National Petroleum Council, "Unconventional Gas Sources—Volume V: Tight Gas Reservoirs, Part I," Library of Congress Card Number 80-82488, December 1980.

Table I
The Tight Gas Resource in Four Rocky Mountain Basins*

	Estimated Gas-in-Place	Maximum Recoverable	Recoverable at Price and Technology		
			$5 Base	$5 Advanced	$9 Advanced
Lenticular	192.1	126.0	47.4	76.4	106.2
Blanket	23.9	16.5	12.3	16.2	16.3
Combined	23.3	15.5	12.6	15.5	15.5
Total	239.3	158.0	72.3	108.1	138.0
Percent Lenticular**	89	88	79	83	87

* Data taken from Tables 9 and 10 of Reference 1 for the Greater Green River, Uinta, Piceance and Wind River Basins. All data are in trillions of cubic feet.

**Ignores combined; assumes same lenticular/blanket ratio.

Table II.
Fracturing Results: MWX-3 Experiment
Hydraulic Fracture

	1	2	3	4
Fluid Volume (gal)	117,500	285,000	344,000	228,000
Sand Proppant (lbs)	400,000	880,000	809,000	448,000
Perf Interval (ft)	30	104	91	18
Design Frac Length (ft)	840	920	860	1648
Post-Frac Length (ft) (Production Match)	110-170	150	100	20-30
Gas Flow, Before (Mcf/d)	60	57	43	55
Gas Flow, After (Mcf/d)	61	137	160	69

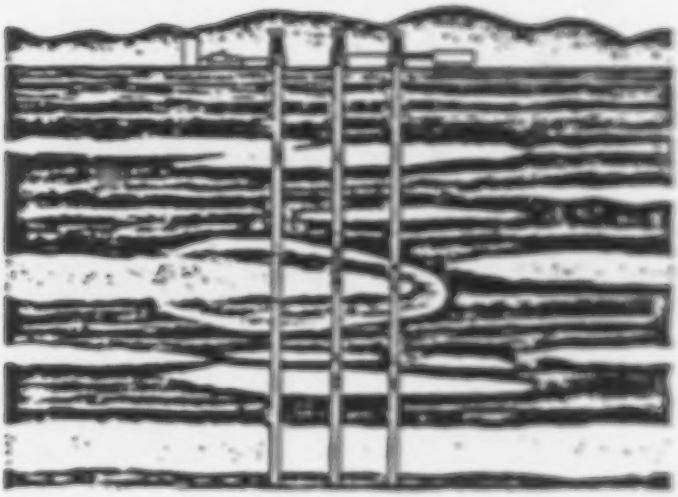


Figure 1. Schematic of the Multi-Well Experiment

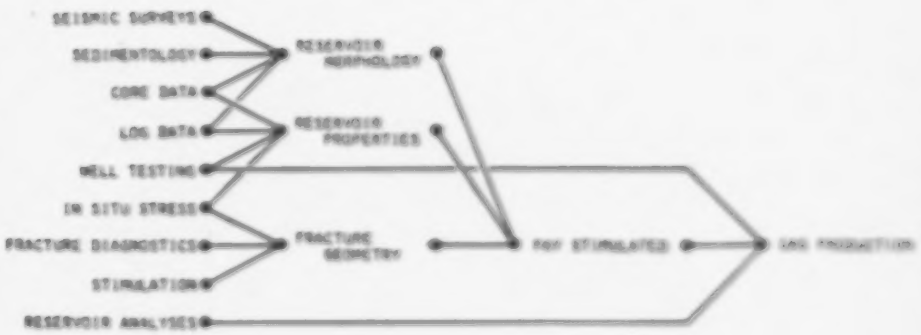


Figure 2. Synergism in MWE activities

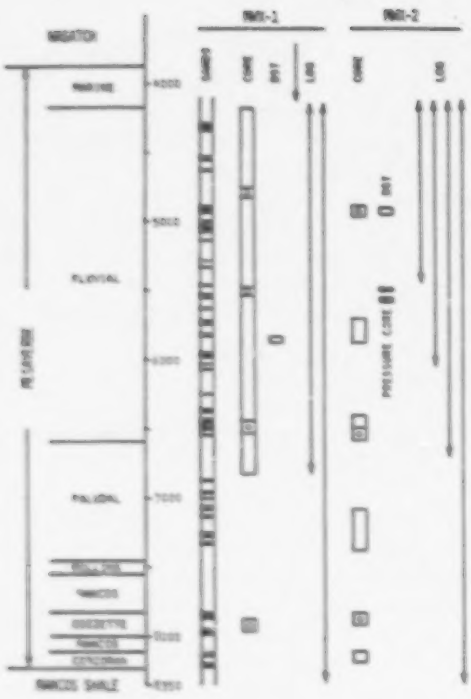


Figure 3. Geology of the Nesaverde and Summary of MWX-1 and MWX-2 Activities

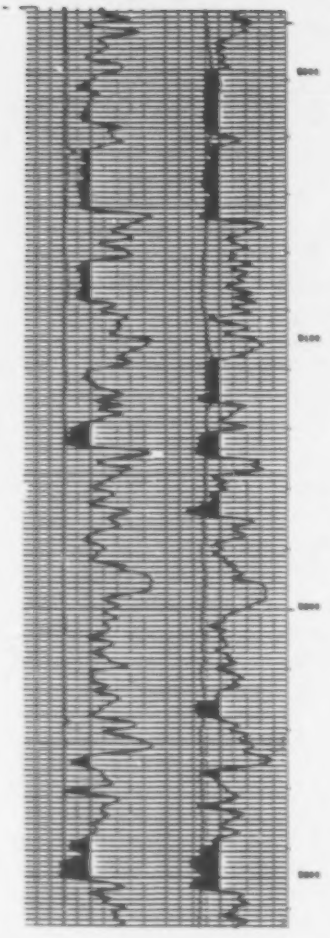


Figure 4. Comparison of Sands in MWX-1 (left) and MWX-2 (right). (Gamma ray log; different calibrations.)

Mr. SENSENBRENNER. Thank you very much.

Mr. Derrick.

Mr. DERRICK. Thank you, Mr. Chairman and ladies and gentlemen. I appreciate the invitation.

El Paso Natural Gas is one of the largest natural gas transmission companies in the country. This is both in terms of sales and size. The company operates a 21,000 mile system serving customers in west Texas, New Mexico, Arizona, southern Nevada, and California. Most of our gas comes from west Texas and New Mexico.

El Paso, as with many other pipeline companies, I would say most of them, has faced periods of gas shortage over its life history. We have had many of these. The company's exploration and development department was started in 1939 to help meet the problem.

When our markets expanded during the late 1940's primarily to California, El Paso looked for additional gas supplies, particularly nonassociated gas supplies. The largest undeveloped basin that we found at that time was the San Juan Basin in northwestern New Mexico. The demand had not been all that great and, also, this had been classified as a tight sands area, not by the FERC but by the producers.

So the producers, due to the low gas price, were reluctant to drill. El Paso found it necessary to go in and start a development program in order to supply the needs of its customers.

The early wells drilled in the San Juan Basin were treated with solidified nitroglycerin. This created production. It was not as good as hydraulic fracturing which came along later. You had Mr. Elkins here this morning and he was very instrumental in developing hydraulic fracturing. He was with Stanolind Oil & Gas Co. That has been described here.

I will say that El Paso has drilled a great many, several thousand wells, in the San Juan Basin area. So we have done a lot of experimenting on our own to develop the optimal methods of hydraulic fracturing to get the best recovery and the best producing rates out of the San Juan Basin.

There were many other operators who followed suit up there.

Hydraulic fracturing does have its limitations. Some reservoirs are so tight that a successful fracturing technique has not been developed to permit economical well development. Such has been our experience in the Pinedale field in southwestern Wyoming. This is a large tight reservoir. El Paso and others have experimented with massive hydraulic fracturing. This is just the extension of regular hydraulic fracturing where larger volumes of liquid and sand are injected under higher pressures.

In order for many of these reservoirs to be developed, it will be necessary to improve the hydraulic fracturing technique to a degree that adequate fracturing of the reservoir will occur. It will be necessary to create a larger fracture system and the fractures will have to extend further from the well bore.

In an effort to accomplish more extensive fracturing, El Paso joined with the AEC under the plowshare program in the mid-1960's to detonate a nuclear device opposite the pictured cliffs producing formation in the San Juan Basin. The experiment contemplated creation of a large chimney surrounding the well bore and fractures extending well beyond. The technical portion of the ex-

periment was successful, but the low permeability of the reservoir precluded an economic venture.

The detonation of the nuclear devices caused concern among certain groups and even though two additional wells in Colorado were stimulated with a nuclear detonation, it is doubtful if additional experiments utilizing nuclear devices will be conducted. The plowshare program was subsequently terminated and El Paso canceled its plans for a similar experiment in Pinedale field in Wyoming.

Until a better method is devised, it appears the industry will not be able to produce the Pinedale gas. When a better method is found, I am confident it will be utilized to develop these tight reservoirs.

In order to increase the ultimate gas recovery and increase the recovery rate, El Paso applied to the New Mexico Oil Conservation Commission in 1974 for an order permitting the drilling of a second well on each 320-acre spacing unit in the Blanco Mesa Verde field in the San Juan Basin. The application was timely approved and permits came almost immediately.

The program has been very successful. The producers have gained reserves and increased present worth of these reserves due to faster recovery rates, and the pipelines have been better able to serve its customers and better utilize its facilities.

The success of the Blanco Mesa Verde in fill program resulted in a similar program in the Dakota field also in the San Juan. This was inaugurated in mid-1979.

Indications are that this program will also be successful. With the increased prices for gas, it appears that the in-fill drilling will find wider application for additional wells. Even though in-fill drilling may not be classified as new technology, it does make more gas available to serve the needs of the consumers.

El Paso in recent years has increased its exploration and development activities to help supply the needs of the pipeline. The company has recently formed a subsidiary, the El Paso Exploration Co., to conduct its exploration and development activities. As long as it is economically feasible, it is anticipated that the producing segment of the gas industry will continue to seek new technology to develop additional gas reserves and also to continue to explore for and develop gas reserves utilizing present technology.

El Paso has been involved in several other projects to acquire additional gas supply. We have been involved in a liquefied natural gas project. we made unsuccessful attempts to put together a coal gasification project in northern New Mexico during the 1970's. More on the positive side, we have been able to develop some substantial gas reserves and also we are importing gas from Mexico.

That concludes my remarks.

[The prepared statement of A. M. Derrick follows:]

THE NATURAL GAS OPTION

NEW RESOURCES AND NEW TECHNOLOGIES

by

A. M. DERRICK

Senior Vice President

EL PASO NATURAL GAS COMPANY
El Paso, Texas

BIOGRAPHICAL SKETCH

A. M. Derrick is a native Texan. He received his formal education at the University of Texas at Austin with a Bachelor of Science Degree in Petroleum Engineering in 1947 and the University of Houston with a Masters of Science Degree in Petroleum Engineering in 1956. He served on active duty in the U. S. Navy from 1943 to 1946.

Prior to joining El Paso Natural Gas Company, he served in various petroleum and reservoir engineering capacities with Stanolind Oil and Gas Company (now Amoco Production Company) commencing in 1947. Subsequently he joined the El Paso Natural Gas Company as a Senior Petroleum Reservoir Engineer in 1953. In 1960 he became Director of Reservoir Engineering; Assistant Vice President in 1966; Vice President in 1972 and Senior Vice President in 1977. He is a member of the Board of Directors of the El Paso Natural Gas Company.

Mr. Derrick is associated with several industry-related organizations and serves as Chairman of the American Gas Association's Committee on Natural Gas Reserves. He is a member of the Potential Gas Committee and has served as a member and chairman of the Gas Supply Committee of the Pacific Coast Gas Association. He is also a member of the Society of Petroleum Engineers, the Society of Petroleum Evaluation Engineers and the American Association of Petroleum Geologists.

Mr. Chairman, I am A. M. Derrick, Senior Vice President with the El Paso Natural Gas Company. I appreciate the opportunity to appear before you today and I would like to have my prepared paper put in the record.

El Paso Natural Gas Company is one of the largest natural gas transmission companies in the country and in 1981 led all other companies with gas sales of 1.26 trillion cubic feet or about 6% of the total United States' production. El Paso has dedicated gas reserves totaling 16.7 trillion cubic feet or over 8% of total U. S. gas reserves.

The El Paso Natural Gas Company was formed in 1928 to deliver gas to the City of El Paso, Texas, at that time the only major city in Texas without natural gas service. A 216-mile pipeline was constructed from southeastern New Mexico to El Paso. Many difficulties were experienced in constructing the pipeline and in obtaining an adequate supply of gas. For example, soon after commencement of deliveries the gas supply was determined to contain an excessive amount of hydrogen sulfide. This necessitated devising a means of treating the gas to remove the hydrogen sulfide. No small task in those days of relatively primitive treating techniques. Fortunately, this was accomplished. The initial deliveries under this project in 1929 coincided with the start of the great depression. Faced with either expanding or going bankrupt, Mr. Paul Kayser, founder of the Company, decided to extend the system into southern New Mexico and southern Arizona in order to increase sales and make the operation a paying proposition.

During the 1930's the Company experienced growth even though the economy was far from being stable. As the gas markets grew, it was necessary to acquire additional supplies of gas. During the 1930's and 40's, the primary source of gas supply in the Permian Basin area of West Texas and southeastern New Mexico consisted of casinghead gas which is gas produced with oil. In order for this gas to be merchantable, it is necessary to process it for the removal of the heavier hydrocarbons. Since the availability of casinghead gas is dependent upon the rate of oil production rather than gas, this created a problem for as the demand for crude oil fluctuated, so did the availability of gas.

By the mid-1940's, California was experiencing a substantial growth in both population and industry, primarily as a result of World War II. The declining gas supplies within the State of California caused the two largest distributors, Southern California Gas Company and Pacific Gas and Electric Company, to look out-of-state for additional gas supplies. And, El Paso was ready to provide such service. In order to satisfy the California market it was necessary for El Paso to expand its gas supply and reduce its reliance upon casinghead gas. By the late 1940's, crude oil was being allowed to produce only a certain number of days in each month. Under this scheme most of the oil allowable was produced the first part of the month to insure maximum oil production since "allowable" could not be carried over. As a result, by the end of the month the gas supplies

from the gasoline plants were markedly reduced. El Paso subsequently extended its line into the Texas Panhandle where a substantial non-associated gas supply was located. El Paso had also commenced its own exploration and production activities.

Even with the steps mentioned above, El Paso still did not have a sufficient gas supply in the late 1940's and early 1950's to meet the growing needs of its market area which now included California so the Company turned to the San Juan Basin in northwestern New Mexico. Gas had been discovered in the San Juan Basin much earlier, but due to the fact that there was not a large market for the gas and the wells drilled in this basin showed a low productivity, not very many wells had been drilled. El Paso's need for additional gas and particularly its need for a non-associated gas supply caused El Paso to enter into the development and production of the gas as a leasehold operator. As a result, the San Juan Basin area of northwestern New Mexico has seen continuous development over the last 35 years.

During the last half of the 1950's and continuing throughout the 1960's, there was substantial development of non-associated gas reserves in the Delaware Basin of West Texas and extending into southeastern New Mexico. Competition developed for these gas supplies however as Transwestern Pipeline Company was formed to also serve the California market and two of the transmission lines serving the Midwest extended their facilities from the Panhandle-Hugoton area in the Texas Panhandle to the Delaware Basin area. To further complicate the supply situation, the Dallas-Fort Worth, Houston and San Antonio areas were growing substantially and gas supplies in other parts of Texas were declining. This caused four large intrastate pipelines to look to the Delaware Basin area for gas supplies. During the late 1960's, the interstate gas pipeline companies were finding it difficult to compete with the intrastate companies from a pricing standpoint because of the control on gas prices exerted by the Federal Power Commission on the interstate pipelines as a result of the Phillips decision in 1954. Consequently, the intrastate companies out-bid the interstate companies and acquired substantial gas reserves in the West Texas area. By the early 1970's, the competition for the gas was primarily between the intrastate pipelines.

The low price for gas decreed by the FPC for interstate gas caused a decrease in exploration and drilling and an increase in demand. El Paso reached the point in the winter of 1972-73 where it was unable to keep its pipelines filled and supply the needs of all of its customers. The Federal Power Commission conducted a series of curtailment hearings to allocate gas supplies based upon customers priorities. The residential and small commercial users were assigned Priority 1 while the large commercial establishments and certain industrial requirements were assigned Priority 2. Priority 4 and Priority 5 categories were assigned small and large boiler users and Priority 3 caught all industrial requirement not included

in Priorities 2, 4 and 5. During the past ten years, El Paso has operated under a curtailment plan, however, with the increasing price of gas compared to alternative fuels, and the recession which we have been experiencing, El Paso has recently been able to supply the needs of all its customers without any difficulty.

El Paso Natural Gas operates a 21,000-mile interstate pipeline system and supplies gas to distribution companies and industries in West Texas, New Mexico, Arizona, southern Nevada and California. El Paso supplies approximately 50% of the gas consumed in California. El Paso's supply areas include the traditional areas of the Permian Basin in West Texas and southeastern New Mexico, the San Juan Basin in northwestern New Mexico, the Panhandle-Hugoton-Anadarko area in the Texas Panhandle, western Oklahoma and southwestern Kansas and newer supply areas in south Texas and offshore Texas. El Paso also imports gas from Mexico. El Paso supplies gas to more than 27 million Americans.

El Paso has maintained an active gas acquisition program throughout its history. As early as 1939 El Paso recognized the need to engage in exploration and development activities to bolster its gas supplies. As mentioned earlier, by the early 1950's El Paso was deeply involved in the development of the San Juan Basin gas reserves. El Paso continued its exploration and development activities throughout the 1950's and early 1960's in an effort to increase its gas supply. An unfavorable FPC decision in the early 1960's resulting in too low a return on exploration activities caused El Paso to retrench this operation. By the late 1960's gas supplies were diminishing and El Paso again became active in exploration and development activities to help provide gas for the pipeline system. El Paso acquired substantial properties in the Anadarko Basin area of western Oklahoma and the Texas Panhandle and this area has proved to be a major contributor to El Paso's gas supply needs. The Company also acquired several properties in the Gulf of Mexico which have since proven to be gas bearing. In terms of gas reserves, El Paso is ranked among the top ten producers nationwide. The Company has maintained a good inventory of leases which of course is required for a successful exploration program. El Paso spent $292 million for exploration and development during 1981 and has budgeted $359 million dollars for similar activities during 1982.

In addition to gas acquisition through gas purchase contracts and the Company's own exploration activities, El Paso has over the years attempted, in some instances successfully and in others unsuccessfully, to acquire additional sources of supply. Some of the more important efforts to improve gas supply and more adequately serve our customers follows.

PROJECT GASBUGGY

Project Gasbuggy was instituted to design, conduct, and evaluate a nuclear stimulation experiment in the Pictured Cliffs formation on an EPNG lease in the San Juan Basin, New Mexico. The test took place on December 10, 1967. Gasbuggy was a joint undertaking with the Atomic Energy Commission and the United States Bureau of Mines, and involved the detonation of a 29-kiloton nuclear device some 4,000 feet underground.

Gasbuggy was considered a technical success. Production data indicated the project well would have produced approximately five times as much gas as a well completed in a conventional manner.

Project Gasbuggy and similar projects have been abandoned because of growing public opposition to the use of nuclear devices for this propose.

INFILL DRILLING

As the gas supply situation deteriorated and the price of gas increased in the early 1970's, El Paso applied to the New Mexico Oil Conservation Commission for an order to permit infill drilling in the Blanco Mesaverde Field in the San Juan Basin. The Blanco Mesaverde reservoir was initially developed on 320-acre spacing or two wells per section. Based upon studies which El Paso and others conducted, it was concluded that the drilling of a second well on a 320-acre space unit would increase the current deliverability of production and also increase the ultimate recovery of the gas.

The New Mexico Oil Conservation Commission approved El Paso's application in late 1974 and infill drilling commenced in early 1975. By the end of 1981, 55% of the gas being produced into El Paso's system from the Blanco Mesaverde reservoir was from the infill wells.

This infill program has been very successful in that it has substantially increased the ultimate recovery of reserves from the reservoir and has provided gas during the period of shortage. It is advantageous to the producer in that it permits the gas reserves to be covered over a shorter period of time and thereby increases the present worth of these reserves. It is advantageous to the pipeline as it permits better usage of the facilities including the gathering systems and the gasoline plants.

Based upon the success of the infill drilling program in the Blanco Mesaverde reservoir, the New Mexico Oil Conservation Commission was asked to permit a similar program in the Basin Dakota reservoir. The New Mexico Commission granted this order in May, 1979 and infill drilling commenced almost immediately. Drilling to date indicates this program will also be very successful.

Infill drilling is continuing in both the Mesaverde and Dakota reservoirs and it will probably be another 15 years before this program is completed.

HYDRAULIC FRACTURING

One of the reasons that development of the San Juan Basin had been deferred prior to the late 1940's was because of the low productivity of the wells. The permeability is a measure of the ease with which fluids can flow through a formation. The lower the permeability or the tighter the formation, the harder it is for a fluid such as oil, gas or water to flow through the formation to the wellbore. This situation was recognized many years ago and solidified nitroglycerin was detonated in early wells in order to create a fracturing system around the wellbore to permit the fluid to flow to the wellbore. In the late 1940's hydraulic fracturing was developed. This stimulation method consists of pumping a viscous fluid into the wellbore under high pressures thus creating a fracture system around the wellbore. A propping agent, such as sand, is also pumped into the formation with the fluid in order to keep the fractures open. The fracturing technique proved very valuable and El Paso did much to improve the technique in the San Juan Basin area. Absent the successful application of fracturing, many of the gas producing areas in the country, particularly the Rocky Mountain area, would not have been developed.

A fracturing technique using large volumes of fluid and a propping agent under extremely high pressures is called massive hydraulic fracturing. El Paso applied this technique in the Pinedale Field in southwestern Wyoming and even though the production was increased, it was not sufficiently increased to permit economic development.

COAL GASIFICATION

El Paso has been involved in coal gasification since the mid-1950's. Much time and money, however, was spent on a project involving the Burnham coal lease located on the Navajo Indian Reservation near Farmington, New Mexico. El Paso and Consolidated Coal Company obtained the lease in late 1968 and did extensive planning and engineering on this project which resulted in a request before the FPC for El Paso to take gas eminating from the project into its system. In 1980 El Paso decided to cease activities in this project because of the tremendous increase in cost which had occurred over the years, plus the availability of much cheaper additional gas supplies due in large measure to the passage of the Natural Gas Act of 1978. El Paso's joint interest in the Burnham coal lease has now been assigned to Consolidated Coal, and El Paso's various other coal rights have either been sold or are in the process of being disposed of.

LNG PROJECT

In 1968 El Paso entered into an agreement with Sonatrach, the Algerian national oil and gas company, for the purchase of an average of one-billion cubic feet of LNG per day. LNG is natural gas that has been liquefied which results in a 600 to 1 reduction permitting economic transportation in cryogenic ships. The gas was to be produced and liquefied

in Algeria and transported in nine specially-built tankers owned and operated by El Paso. The LNG was to be delivered at Cove Point, Maryland and Elba Island, Georgia into facilities owned by the purchasers.

Deliveries of LNG to the customers began in March, 1978 and eventually reached an average of about 650 million cubic feet per day. The liftings of the LNG in Algeria were discontinued by Sonatrach in March, 1980 because of a price disagreement. The differences were never resolved, and in February, 1981, El Paso announced its decision to discontinue the LNG operations and wrote down the value of its LNG assets as of year-end 1980.

STORAGE

El Paso has recently completed construction work on the Washington Ranch Storage Project located near Carlsbad, New Mexico. The reservoir has a capacity of approximately 68 billion cubic feet of gas and will be capable of delivering about 400 MMcf of gas per day during periods of peak demand.

Previously, the Company was able to meet the high priority needs of the east of California customers through line pack and curtailment of lower priority customers while the California distributors historically provided their own storage. With a declining gas supply, it has become necessary to provide storage to meet the peak-day requirements of the high priority east of California customers. The facilities for the project cost approximately $61 million and the cost of the gas to be injected will exceed $100 million.

RESEARCH AND DEVELOPMENT

El Paso Natural Gas relies on the Gas Research Institute and the American Gas Association for most of its research and development.

The Gas Research Institute ("GRI") plans, manages and develops financing for a cooperative research and development program for the mutual benefit of the gas industry and its customers. Funding for this program is provided primarily through a funding unit charge added to the rates for gas sold for resale by GRI's 29 interstate pipeline company members. Responsibility for this program lies within a board of directors elected by GRI members which provides for an equitable representation of interstate pipelines companies, gas distributors, private companies and municipalities, and the broad public interest.

The American Gas Association ("AGA"), a trade association supported by most of the major gas transmission companies and distributors, sponsors a research laboratory in Cleveland, Ohio. This laboratory conducts tests for many of the gas appliance manufacturers in addition to its research activities. The manufacturers bear the cost of the testing while most of the research costs are funded by the AGA through its member companies.

CONCLUSION

As I see it, the natural gas industry is faced with three major areas of concern: 1) that the pipeline companies are allowed to earn a fair rate of return in order to provide the distribution companies their required services; 2) the ability of the distribution companies to maintain, through a proper rate design, the large industrial and boiler fuel markets on an interruptable basis; and, 3) when will the deregulation of natural gas prices occur. The first is the responsibility of the Federal Energy Regulatory Commission, the second is a function of the State regulatory commissions, and the third lies within the domain of Congress.

I am hopeful that all three areas will be resolved in a manner acceptable to the public, to the regulators, and to the industry.

Mr. SENSENBRENNER. Thank you very much, Mr. Derrick. I have one brief but philosophical question which I would like all of you to respond to.

As you know, the Congress is debating whether to accelerate decontrol that was put into law as part of the Natural Gas Policy Act of 1978.

Just in the past week, two conflicting studies were released, one a joint effort by the Committee for Economic Development and the Conservation Foundation which concluded that natural gas should be immediately decontrolled; and second, a study by the Consumer Federation of America which reached the opposite conclusion.

We had some questions of the previous panel as to whether the immediate decontrol of all natural gas prices would spur R&D into extracting more natural gas. Dr. Gold seemed to indicate that he thought that would and Mr. Benner reached the opposite conclusion.

Let me ask you three gentlemen the question of what the relationship do you think decontrol of natural gas prices would be having on the amount of money spent for R&D.

Mr. SLATER. I guess I will go first.

If gas prices are decontrolled, and you said immediately, and I think you mean all prices decontrolled, completely decontrolled, I think you will see a tremendous amount of money spent on R&D in the areas of tight gas technology, and in all gas technology.

The reason is right now, this is talking for Yates Petroleum and other operators, drilling a well to 8,000 or 10,000 feet and with gas selling for $2.50 an Mcf you cannot justify a lot of drilling, let alone any technology-type work.

If gas was to be decontrolled, I believe that $2.50 would increase. That would be the spur that would cause the drillers to do more drilling and the technology needed to go along with that would be obtained. I think the price of deep gas, 15,000 to 25,000 feet, would probably drop a little. Overall, I am sure it would be best for the consumer because they would be assured of gas supplies not only now but in the long term.

One really important thing to look at, just a good rule of thumb, when people are talking about decontrol, ask the man what his reserves are, that is like how many Mcf of gas he thinks he has in the ground. Then ask producing rates.

Say a man has 1 Bcf of gas in the ground. If he produces 300 million a year, his life is only 3 years. He has no gas to sell at that time and we all suffer.

So we need to do this for the long term.

Mr. NORTHROP. I cannot speculate from the industry perspective, but I have my own thoughts on this. I think that a large amount of money produced by decontrol will spur some research and development by industry, but its target will be the easiest and the best of the reservoirs. This was alluded to by Mr. Benner in his talk. He talked about the spectrum of difficulty in producing the tight gas resource.

The lenticular type of gas resource is a very large one, and could contribute to this Nation's security. It behooves the Government to support an R&D program to determine whether or not that is available to this country.

I do not think that money arising from immediate decontrol of gas would be applied by industry to such a long-term target.

Mr. DERRICK. Looking at it from the pipeline standpoint, I would support the Natural Gas Policy Act deregulation as provided for in 1985. There is a great deal of surplus gas available in this country today, and the prices are bucking up against the market clearing price.

It was mentioned earlier about the California powerplants burning gas. We have had surplus gas all this year that was available to them but due to the rate designed by the California Public Utilities Commission, the price of gas to the powerplants is above the price of low sulfur No. 6 fuel oil in many instances.

So the powerplants, until the smog alert about 10 days ago in the L.A. Basin, have been burning oil. So if we deregulate gas there has to be something that would regulate it, and I suppose it would be supply and demand. Hopefully it would be.

But there is a limit on how much gas can be marketed in competition with other fuels.

Mr. SENSENBRENNER. That leads to my second point. Recently Southern California Gas objected to a price increase proposed at the FERC on the basis it would force large industrial users to switch to alternative forms of energy such as fuel oil.

Mr. DERRICK. Yes.

Mr. SENSENBRENNER. Given the fact that you said the Natural Gas Policy Act of 1978 has provided adequate supply of gas for the American people—which I believe it has—does that not reach the conclusion that the increase in the price of natural gas caused by immediate deregulation may well not be all that big a boon to the natural gas industry as some claim it would be?

Mr. DERRICK. I think that is exactly right. If we are at the market clearing price now and if the price of one vintage of gas goes up, there will have to be an offset.

Mr. SENSENBRENNER. Thank you very much.

The Gentleman from New Mexico, Mr. Skeen.

Mr. SKEEN. Thank you, Mr. Chairman.

This is the way we do it back in the big city.

The question I have of all three members to begin with, we notice from testimony before the committees in Washington that there is a vast and marked difference in the attitude of petroleum

producers and marketers, as an industry, as opposed to the natural gas industry.

This surprises many people in the Eastern parts of the United States because when you say oil and gas to a lot of those folks, you are talking about the same industry. The fact is they are entirely two different industries and it has been difficult to make the distinction.

When you talk about deregulation of the petroleum industry, and you are talking to a more homogeneous group in their makeup, but when you talk about that really you are talking about almost three separate entities.

Has there been any attempt by the three portions, the producer, transporter, and distribution people to get a closer viewpoint or come closer together on how they feel about rapid deregulation?

Mr. DERRICK. Well, as you know there have been a lot of moves afoot. The API pushed for total deregulation. The pipeline people worked through the American Gas Association and INGAA. There has been a lot of discussions but as I understand it, there were so many compromises that went into the Natural Gas Policy Act of 1978 that if that is reopened there is going to be a lot of people coming forth with other proposals.

Mr. SKEEN. I think that is probably true. I think the whole thing has to do with the windfall profits tax, too, in gas producing and distribution and so forth.

How we will handle that situation, I do not know, but that is the tradeoff. I wonder, does that create alarm within the industry itself?

Mr. DERRICK. Well, I know the distributors and I would think producers also and certainly the pipelines are concerned about gas being priced at or below the market clearing price in order that the gas can be marketed.

Mr. SKEEN. Thank you.

Mr. Slater, I would like to ask you and Dr. Northrop to cooperate on maybe a response to this kind of question.

At what point in research and development dealing with these techniques can you make a determination that it is economically feasible for private industry to take on the work or is it a gradual transition? What recommendations do you make to take the primary research being done within organizations such as the Department of Energy that you are with, Dr. Northrop, into an organization such as Mr. Slater's and accepting the responsibilities for further development of and commercial applications of that.

Mr. NORTHROP. There is no doubt that the industry interest, say, in our work is there. We have had lots of inquiries. We will have well over 60 people coming to a workshop in Grand Junction next week just to view core from the multiwell experiment.

I think what industry would like to see from us is this information made available to everybody. In their inquiries to us, they say: Is that information available or is it proprietary? We say: This experiment has been done with Government funds, thus, all data, every bit of it, is available. They come, sort through it, take it home with them, and work with it.

We are really providing a service here. Here is a wealth of data and a wealth of information from a scope of activities that are un-

precedented. No one company could afford to do this on their own. This provides a unique opportunity.

Mr. SKEEN. So it is left open to the determination of that particular company in their applications.

Mr. NORTHROP. That is right. So much depends on their holdings and what they have.

Mr. SLATER. There are two types of people in this world, Mr. Congressman, the quick and the dead.

Mr. SKEEN. We have noticed.

Mr. SLATER. Take the Abo, there was no research for us to work on the Abo. Yates Petroleum, Mesa Petroleum, other independent operators in Roswell basically took it on themselves to get the work done. We could not wait 10 years for the work to go on. We are all for the research but it has to be economical, or the consumer would not buy the gas.

Mr. SKEEN. In connection with that, Mr. Slater, I would like to comment that Yates Petroleum has been a pioneer in development of the tight formations gas in this part of the country. I think their history goes back many years and their interest in this particular type of operation has been tremendous.

What inkling did the company have so many years ago that led them to stay in such a risky area? Was it their own research or what?

Mr. SLATER. What it was really, Mr. Congressman, was some people in business for the long-term and not for the short-term buck. In oil and gas the name of the business is acreage. They have been in this business 40 or 50 years and they have been able to build this up, and for that reason they are in it.

At Yates Petroleum, it is like this, figure out a way to get the job done and go from there.

We do not point the finger, that type of thing. I am not sure I am answering your question very well.

Mr. SKEEN. It probably was not a very good question, but it sparks the interest I have. This is what we are trying to get into the testimony. The kinds of interests generally taken on by independent producers have been the backbone really of the progress and the thrust of the development that has taken place.

When private companies and individuals who form companies—and we do a lot of that in this part of the country, which is not well understood in the East. Everyone back there thinks anyone in the oil and gas is a J. R. Ewing, and belongs to Dynasty and has all sorts of those problems.

This is how we are viewed.

I just want to make the point that it is still representative of people who have individual intelligence and they use it and have a long-term interest in providing energy. It is not totally greedy, or in any way avaricious; it is their business. It is the private sector, it is the best area to do it.

Mr. SLATER. I would have to agree with you.

Mr. SKEEN. I am not trying to pat us on the back. I just want us understood a little better so when you stand up on the floor talking about what we do with oil or gas, I do not want those folks to think that the only thing they have to say is "tax it."

It takes a lot of production and there is a lot of thought and an awful lot of preparation and investment over many years for going into this.

Mr. SENSENBRENNER. Just to get the record straight, there are some from the East that voted against the windfall profits tax and I am one of them. [Applause.]

Mr. SKEEN. But this is interesting. I think this is what we are trying to do with this exposition today. You certainly contributed to it well and I appreciate it. We are not leading you into anything. We will let the lawyers do that.

Anybody on staff have questions?

Ms. KREBS. I would like to follow up on the question I think Mr. Skeen was getting at with Mr. Slater.

In your charts you indicated that you could save money if you could increase the size of your fracs and decrease the number of wells and fracs that you had to drill.

I think that one of the things that would be interesting is how are you going about doing this? Where are you getting your expertise? Who are you interacting with? Does the Government program make a difference, if not, how do you do a better job or how can the Government do a better job?

Mr. SLATER. First of all, it is a team effort. All the operators share the information on how to get a better frac job, we have changed our techniques probably monthly on how we frac the wells. Each month we think this might be a better idea; we used to use CO_2 because it cleans the well up faster and blows the frac back better. It costs $4,000 or $5,000 a well to do the job. We have since learned we do not need to use CO_2 unless it is a very poor well in which case you would have to use it.

But the other part, the real teamwork I refer to is the work with the service companies such as Halliburton, Western Companies, these companies all maintain their own research departments and they are by far the people we lean on to get this information. We certainly encourage the Government to do the research they want to do but as I mentioned earlier, we need the information now and in many cases we will try unproven expensive technology to try to get the job done.

In the Abo we have a great many wells and a test program for these multiple wells just north of Roswell, they are available for research programs.

Mr. NORTHROP. I would like to add to that. You mentioned the service company research. The service companies have worked with Sandia, for example, in the fracturing experiments I referred to in the Nevada test site. We utilized them in doing fracture design and they were involved in looking at the results. Those results, in turn, have affected how they view hydraulic fracture behavior and their models that they pass on to the industry.

Ms. KREBS. Thank you.

Mr. SKEEN. Bob.

Mr. LAMINA. I would like to ask Dr. Northrop how budget reductions imposed by DOE are affecting your gas recovery program at Sandia?

Mr. NORTHROP. Currently, we have funds to operate into fiscal year 1983. Under the President's budget there are no more funds

for our program past that. We could do two stimulations at the multiwell experiment with existing funds, and get a minimal amount of data out. But the long range, carefully planned program, would not be possible.

Mr. SKEEN. Can you get some significant information on this, how far along are you on the multiwell? Do you have two wells?

Mr. NORTHROP. We have two wells completed, 4,000 feet of core, and a very comprehensive analysis program. We have a large geophysical survey that was done at the site. We have done the in situ test to determine stress in the pay zones. We are about to do the first well testing, and the first stimulation will be done in November.

We have essentially created the laboratory, and now we are ready to do some experiments.

Mr. SKEEN. I want to thank you all for bringing this information to the subcommittee. I thank each of you for your significant contributions. I appreciate it very, very much.

We will come back at 1 o'clock this afternoon and resume with the last panel that will deal with the socioeconomic impacts of this field.

Thank you very much.

AFTERNOON SESSION

Mr. SKEEN [presiding]. I want to thank all of you for coming back, those of you that stayed over. I want to say we have certainly appreciated the participation that we have had.

I explained earlier this morning—maybe some of you were not here—Congressman Dick White could not be here. The rules are that when you have a formal hearing in the field, that it is usually chaired by a member of the majority party.

Since he is also a subcommittee chairman, having a great deal of influence on what happens with the Department of the Defense appropriation authorization, he felt he could not be here.

However, we will put this information in the record. It will be printed as a committee hearing, and will have a great deal of value.

We appreciate the participation that we have had.

I want to introduce again the panel. Jim Sensenbrenner, who is the Congressman from Wisconsin, who was with me this morning, had to catch a plane out, which left just a few minutes ago. I want him to know how much I appreciate his coming here.

We had to leave the floor of the House yesterday about a quarter to 5 to run out and catch our airplanes and get into Albuquerque about 10 o'clock last night. The next morning we had to catch the world's greatest intercity airline, Air Midwest, down to Roswell. That left us a good hour before we started this morning, but 6:50 in the morning is early. But I want to introduce to you the people who really have done a lot of work in putting this together and deserve a lot of credit. They make us in Congress look very good because they are very bright people, very capable people, and I want to start with Martha Krebs. She is on the committee staff, majority

side. We don't always make that distinction. She is a real fine lady and has done an outstanding job.

Lee Wallace is on the committee staff, and he is on the minority staff. They make those distinctions. Doesn't make a heck of a lot of difference to us around here. The gentleman who is with me on my personal staff is Bob Lamina, and he is a Pennsylvanian, but is rapidly becoming a native New Mexican. One more injection, maybe. He already offered to help someone ranch out here. I don't know who got him roped.

We had two panels this morning that gave extensive testimony, and I think in my opinion some of the best input into the problems of gas recovery techniques as practiced in this portion of the oil and gas industry, but particularly the New Mexico area, because we have added significantly to the gas reserves of the United States in just this one area alone in the last few years.

It was caused by dedicated companies, individuals, and so forth, that spent their lives with the techniques and expanding technologies of tight sand gas formation recoveries, as it is called. There was significant and extremely worthwhile testimony. I thought I knew something about the techniques and the science involved, having lived around this most of my life. I learned a great deal this morning.

This afternoon, we are going to take up another facet of the question; that is, the socioeconomic impacts on communities caused by the kind of development that we have had. We have had rapid development in our case, in southeastern New Mexico.

We are a long-time oil- and gas-producing community. We understand very well what it takes to produce this resource and the impact on communities. What do you do about the housing, the roads, how you provide the police and fire protection, and so on, is an integral part of this.

The panel we have this afternoon is the largest one, and I want to introduce them. We are going to take up the question of what the impacts mean and how we should handle it, what should be the Federal responsibility, since it is the Federal Government that is the biggest landlord, in the State of New Mexico.

I would like to introduce to you Dr. Charles Turpen, the Honorable Charles Turpen, secretary of the department of energy and minerals for the State of New Mexico. He has with him some outstanding persons on his staff, and I would invite you to ask them to participate to whatever degree, when you have some signficant portion of testimony that you want them to engage in.

We want to keep this testimony as short as possible, so we have time for questions. You are a large panel, so we have to move along. We have Dorothy Hellums, county commissioner of Chaves County, and we are grateful to have such capable women involved in these areas.

We have Jerry Don Martin, a rancher, and we are glad you are here, because the surface land users are always one of the facets of production that we have yet to deal with, and the production companies deal with.

We have Mr. Bill Armstrong—who needs to introduce Bill? What a fine family man and group of participants we have in civic affairs in this part of the country. Good to have you here.

Last, but of course never least, is Peter Hanagan, a product of Roswell, one of the most outstanding individuals I have had the pleasure to know. He is executive vice president of the New Mexico Oil and Gas Association. We are glad to have you here.

Would you start over here, and I will let you take off, and we will go down the panel.

STATEMENTS OF CHARLES TURPEN, SECRETARY, DEPARTMENT OF ENERGY AND MINERALS, STATE OF NEW MEXICO; DOROTHY HELLUMS, COUNTY COMMISSIONER, CHAVES COUNTY, N. MEX.; JERRY DON MARTIN, RANCHER; BILL ARMSTRONG, JR.; AND PETER HANAGAN, EXECUTIVE VICE PRESIDENT, NEW MEXICO OIL & GAS ASSOCIATION

Mr. HANAGAN. Thank you, Mr. Chairman.

I am Peter Hanagan, the executive vice president of the New Mexico Oil and Gas Association.

As many of you may know, the association is a volunteer organization established 54 years ago, made up of nearly 400 individuals and companies, large and small, operating in every segment of the oil and gas industry in the State.

Members of the association account for more than 90 percent of the oil and gas produced in New Mexico, 75 percent of oil and gas wells drilled, and 80 percent of footage drilled.

The purpose of my testimony is rather limited. It is to help familiarize the subcommittee with the social and economic impacts of oil and gas activities in New Mexico. With an understanding of the industry's extensive presence in a producing State like New Mexico, the need for developing new technology and regional planning to mitigate impacts becomes clear.

First, with respect to oil and gas drilling, at the beginning of 1982, there were 34,727 active wells—15,560 gas; 19,167 oil—in New Mexico.

In 1981, the industry drilled 2,727 wells—1,576 gas; 873 oil; 278 dry holes—which represented the greatest number ever drilled in the history of the State. More than 55,000 wells have been drilled in the State since the start of commercial production in 1921.

With respect to production and sales price, I would like to say New Mexico is fourth among the States in natural gas production and seventh in oil production. The 1981 wellhead sales price for the 1.118 trillion cubic feet of natural gas was $2.333 billion, and for the 72.2 million barrels of oil was $2.449 billion, for a total of $4.782 billion.

To put these numbers in perspective, the 1981 production value of coal was $360 million; uranium, $285 million; copper, $288 million; potash, $290 million; agricultural crops, $329 million; livestock and livestock products, $773 million. Thus, the 1981 value of oil and gas production more than doubled the combined value of agriculture, livestock, and the principal other extractive minerals.

From this activity the State does receive a lot of revenues. From oil and gas production in 1981, New Mexico received $998.6 million by way of direct taxes, royalties, bonuses, and similar direct revenues. This prorates out to $2.7 million a day, or $113,997 an hour.

As a reference point, the State's general fund revenues for fiscal 1981–82 were $1.3 billion.

The oil and gas industry is the State's largest single source of revenue, exceeded only by gross receipts taxes. Forty-eight percent of total general fund revenues are directly traceable to oil and gas sources. Much of the money collected goes to public education.

The oil and gas industry is a prime source of support of the educational system. Every school district in every county received oil and gas revenues, even though 95 percent of the oil and gas production derives from only four counties. The public schools' share from oil and gas more than equals the salaries of every teacher and principal in the State as well as the total expenditures for textbooks and other instructional materials.

The industry is one of the State's largest nongovernmental employers, providing jobs for approximately 27,000 persons, with 16,000 in natural gas and crude oil extraction. This figure does not include indirect employment fostered by oil and gas activities in such areas as banking, insurance, law, accounting, and others.

Public lands—New Mexico, with its 77.7 million acres of land, has an unusually high concentration of ownership by public landlords. Fifty-five percent of the land mass is owned by government entities, either Federal, State, or Indian tribes. As a result, 85 percent of the natural gas and 80 percent of the oil is produced from public lands. Most of the gas—57 percent—and much of the oil—30 percent—is produced from Federal land.

Of course, such extensive and intensive oil and gas activity causes disturbance to the land surface. This is an unavoidable consequence of exploration and development, despite efforts to minimize such disturbance. The oil and gas operator is aware of his obligations to the various governments who own the lands upon which he operates.

He also recognizes his responsibilities to ranchers and other surface tenants who do not own the land but occupy the common public space alongside several fellow cousers of the land.

I appreciate the chance to present this brief overview of New Mexico and will be happy to respond to questions.

Mr. SKEEN. Thank you.

Mr. HANAGAN. I will be happy to respond to questions at your convenience.

[The prepared statement of Mr. Hanagan follows:]

STATEMENT OF PETER HANAGAN, EXECUTIVE VICE PRESIDENT, NEW MEXICO OIL & GAS ASSOCIATION

Mr. Chairman and members of the subcommittee, I am Peter Hanagan, Executive Vice President of the New Mexico Oil & Gas Association. The Association is a voluntary organization, established 54 years ago, made up of nearly 400 individuals and companies, large and small, operating in every segment of the oil and gas industry in New Mexico. Members of the association account for more than 90 percent of the oil and gas produced in New Mexico, 75 percent of oil and gas wells drilled, and 80 percent of footage drilled.

The purpose of my testimony is rather limited. It is to help familiarize the subcommittee with the social and economic impacts of oil and gas activities in New Mexico. With an understanding of the industry's extensive presence in a producing state like New Mexico, the need for developing new technoloigy and regional planning to mitigate impacts becomes clear.

First, with respect to oil and gas drilling: At the beginning of 1982 there were 34,724 active wells (15,560 gas, 19,167 oil) in New Mexico.

In 1981, the industry drilled 2,272 wells (1,576 gas, 873 oil, 278 dry holes), which represented the greatest number ever drilled in the history of the state. More than 55,000 wells have been drilled in the state since the start of commercial production in 1921.

With respect to production and sales price: I would like to say New Mexico is fourth among the states in natural gas production and seventh in oil produciton. The 1981 wellhead sales price for the 1.118 trillion cubic feet of natural gas was $2.333 billion, and for the 72.2 million barrels of oil was $2.449 billion, for a total of $4.782 billion.

To put these numbers in perspective, the 1981 production value of coal was $360 million; uranium, $285 million; copper, $288 million; potash, $290 million; agricultural crops, $329 million; livestock and livestock products, $773 million. Thus, the 1981 value of oil and gas production more than doubled the combined value of agriculture, livestock and the principal other extractive minerals.

State revenues: From oil and gas production activities in 1981, New Mexico received $998.6 million by way of direct taxes, royalties and bonuses. This prorates out to $2.7 million a day or $113,997 an hour. As a reference point, the state's general fund revenues for fiscal year 1981 and 1982 were $1.3 billion.

The oil and gas industry is the state's largest single source of revenue exceeded only by gross receipts taxes. Forty-eight percent of total general fund revenues are directly traceable to oil and gas sources.

Public education: The oil and gas industry is also a prime source of funds for New Mexico's public educational system. Every school district in every county received oil and gas revenues even though 95 percent of the oil and gas production derives from only four counties. The public schools' share from oil and gas more than equals the salaries of every teacher and principal in the state as well as the total expenditures for textbooks and other instructional materials.

Employment: The oil and gas industry is one of the state's largest nongovernmental employers providing jobs for approximately 27,000 persons with 16,000 in natural gas and crude oil extraction. These figures do not include indirect employment fostered by oil and gas activities in such areas as banking, insurance, law, accounting and others.

Public lands: New Mexico, with its 77.7 million acres of land, has an unusually high concentration of ownership by public landlords. Fifty-five percent of the land mass is owned by government entities, either federal, state or Indian tribes. As a result, 85 percent of the natural gas and 80 percent of the oil is produced from public lands. Most of the gas (57 percent) and much of the oil (30 percent) is produced from federal land.

Of course, such extensive and intensive oil and gas activity causes disturbance to the land surface. This is an unavoidable consequence of exploration and development despite efforts to minimize such disturbance. The oil and gas operator is aware of his obligations to the various governments who own the lands upon which he operates.

He also recognizes his responsibilities to ranchers and other surface tennants who do not own the land but occupy the common public space alongside several fellow co-users of the land.

I appreciate the chance to present this brief overview of New Mexico and will be happy to respond to questions.

Oil and Gas

What They Mean To New Mexico

Jobs

More than 27,000 New Mexicans are employed in jobs directly related to oil and gas production, refining, processing, marketing, transportation or field services.

Revenues

As the greatest source of State revenue, the oil and gas industry paid New Mexico more than $998.6 million in direct taxes and revenues in 1981. This amounted to $2.7 million every day, or $114,000 every hour.

Public Education

New Mexico public schools received $297 million from oil and gas revenues for their 1980-1981 operational funds. That was enough to pay the salaries of every teacher and principal, as well as the total costs for textbooks and other instructional materials.

$2 Billion Nest Egg

Monies in New Mexico's two permanent funds now exceed $2 billion. Oil and gas revenues account for 95% of the State Permanent Fund's estimated mid-1982 total of $1.4 billion, and 85% of the $690 million in the Severance Tax Permanent Fund. These Funds will help sustain future generations against the day when oil, gas and other minerals are depleted.

For more information contact
Peter Hanagan or Maurice Trimmer at the

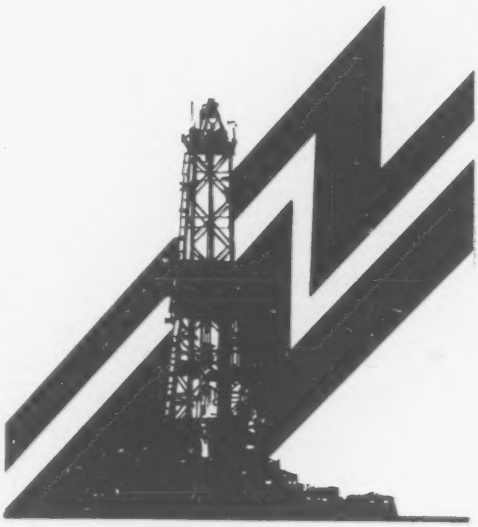
New Mexico Oil & Gas Association

1227 Paseo de Peralta
P.O. Box 1864
Santa Fe, N.M. 87501
Telephone (505) 982-2568

New Mexico

Oil and Gas

Facts '82



General

1. Ranchers and farmers reported finding oil and gas in well water and ground seepage in the late 1800's. However, it was nearly a decade after New Mexico became a state in 1912 before drillers found supplies large enough for commercial development.
2. Natural gas was first produced in salable quantities in New Mexico near Aztec in 1921.
3. The first discovery of a commercial oil supply occurred in the San Juan Basin a year later.
4. New Mexico ranks 4th among the states in the production of natural gas.
5. The state is 7th in the production of crude oil.
6. Crude oil and natural gas account for about three-fourths of the value of New Mexico's total mineral production .
7. New Mexico is the 5th largest state in area with more than 77.7 million acres. The U.S. Geological Survey has classified about 84% of the state (65 million acres) as prospective oil and gas lands — "areas where geologic conditions offer some possibility for the occurrence of oil and gas."
8. 55% of the land in New Mexico is owned by government entities — federal, state and Indian — a total of 42.6 million acres. About 58% (24.7 million acres) of this government land is leased for oil and gas exploration and production.
9. 47% of the oil and 23% of the natural gas produced in New Mexico comes from lands owned by the State.
10. 30% of the oil and 57% of the gas are obtained from Federal lands.
11. 3% of the oil and 5% of the gas come from Indian trust land.
12. The balance — 20% of the oil and 15% of the gas — is produced on private land.
13. Total number of wells drilled all time in New Mexico up to January 1, 1982, came to 52,662. 49.9% were oil wells, 28.9% gas, and 21.2% were dry holes.
14. Four of the 100 largest oil fields in the U.S. are in New Mexico. They were discovered before 1930.
15. The petroleum industry is one of New Mexico's largest non-governmental employers, providing jobs for 27,000 men and women.
16. More than 3,000 products are made from petroleum. Among them are plastics, fertilizers, synthetic materials for clothing such as polyester and nylon, tires, antibiotics, paint, pesticides, furniture, and cassette recorders.

Drilling

17. New Mexico producers drilled 2,727 wells in 1981, the highest number in the history of the State. Of this total, 873 were oil wells, 1,576 were gas wells, and 278 were dry holes. That was the largest number of total wells and of gas wells ever drilled in New Mexico in one year.
18. The 1981 total was an increase of 509 wells over 1980, the previous peak year. It was 1,913 more than the modern low of 814 wells in 1970. The best year prior to 1980 was 1957 with 2,205 wells.
19. 364 "wildcat" oil and gas wells, which seek new fields, were drilled in 1981. Some 153 of these wildcat wells (42%) were dry holes.
20. New Mexico drilling in 1981 totaled over 14 million feet of hole, the most drilled in any one year. The average depth per well was 5,162 feet.
21. The deepest well drilled to date, 22,926 feet in Lea County in 1968, was a dry hole.
22. There was an average of 134.9 rotary rigs operating each day in the State in 1981. That was 17.3 more than the average for the prior year.
23. Approximately $809.7 million was spent for drilling and completing wells in 1980, the latest year for which those figures are available.
24. The average cost per well ran $356,091 for dry holes; $352,022 for oil wells; $439,309 for gas wells. (Note: The cost to drill and complete a deep gas well in the Carlsbad area frequently runs over $1.)

Production and Reserves

25. Eight of New Mexico's 33 counties have a history of oil and/or gas production: Chaves, Eddy, Lea, and Roosevelt in the southeast, and McKinley, Rio Arriba, San Juan and Sandoval in the northwest. Mora produces a small quantity of gas, and Harding is becoming a valuable source of carbon dioxide.
26. 93% of the State's oil production and 98% of its natural gas came from four counties — Lea, Eddy, San Juan and Rio Arriba.
27. Land area proved productive of oil and/or gas comprises about 3.3 million acres out of the State's total of 77.7 million acres.
28. New Mexico produced 72.2 million barrels of crude oil in 1981, or 3.2 million fewer barrels than the previous year, a decline of 5.4%.
29. The State's largest production year was 1969 with 129.2 million barrels of crude oil.
30. An estimated 46% (33.1 million barrels) of the State's 1981 oil yield was produced by using secondary recovery techniques and pressure maintenance.
31. About 18% (13.5 million barrels) of the State's oil production came from stripper wells — those producing fewer than 10 barrels a day.
32. 1.118 trillion cubic feet of natural gas were produced in 1981, down 1.2% from 1980.
33. The largest annual production of natural gas to date was 1974 when the state's total reached 1.229 trillion cubic feet.
34. There were 19,167 oil wells and 15,560 gas wells which were active (producing or capable of producing) at the end of 1981.
35. 81% of New Mexico's oil wells must be pumped; only 19% flow from their own pressure.
36. The average price of crude oil in New Mexico in 1981 was $34.29 per barrel, up $10.29 from 1980.
37. The average price of natural gas was $2.15 per MCF (thousand cubic feet) in 1981, up 35¢ from the previous year.
38. The average production of crude oil per well was 11.1 barrels per day at the end of 1981, down .8 barrel from 1980.
39. 131 depleted wells were abandoned during 1981, compared to 181 in 1980.
40. Proved reserves of New Mexico crude oil as of December 31, 1980, were estimated at 547 million barrels, down 16 million from the year before. The all time high was 1.1 billion barrels in 1962.
41. Natural gas liquids proved reserves were 541 million barrels, up 11 million from the previous year.
42. Proved reserves of natural gas reached 13.287 trillion cubic feet, down 437 billion from 1979.
43. More than 16,000 New Mexicans were employed in the production of crude oil and natural gas during 1981.

Transportation

44. There are more than 25,000 miles of oil and gas pipeline in New Mexico. The total pipeline miles exceed the combined mileage of the state's railroads and highways.
45. This noiseless, virtually invisible, noncontaminating and safe transportation system provided direct full-time employment for 260 people in 1981.
46. The two major petroleum product pipelines serving the state transported an average of 34,815 barrels of gasoline and distillates per day, with the remainder carried by truck and rail.

Refining and Processing

47. New Mexico's 7 refineries were capable of processing 125,430 barrels of oil per day in 1981.
48. These refineries employed 642 persons.
49. Receipts of crude and condensate at the refineries equalled 41% of New Mexico's total production in 1981. 91% of all crude and other liquids they refined came from New Mexico production.
50. These refineries' major products included 12.4 million barrels of gasoline, 8.9 million barrels of distillate, 2.3 million barrels of residual and 4.1 million barrels of kerosene and jet fuel.
51. There are 46 natural gas processing plants in New Mexico. These plants processed more than 982 billion cubic feet of natural gas during 1981.
52. They produced 53.8 million barrels of butane, propane, natural gasoline and other products.

Marketing

53. There were 1,200 service stations operating in New Mexico in 1981, employing 4,200 persons.
54. Some 742.5 million gallons of motor gasoline were sold in the state in 1981, a decrease of 4.1 million (0.5%) under the previous year, and a drop of almost 10% in three years. New Mexico ranked 36th among the states in the amount of gasoline sold.
55. The average daily consumption of gasoline amounted to about 2.03 million gallons in 1981, or some 11 gallons per week for each New Mexican.
56. About 3.9 million barrels of butane and propane were sold in New Mexico in 1980.
57. About 10% of the natural gas produced in New Mexico is sold in-state.
58. There were 7.9 million barrels of distillate (light) fuel oil, 939,000 barrels of residual (heavy) fuel oil, and 1.3 million barrels of kerosene sold in the state in 1980.
59. About 85% of the distillate fuel was in the form of diesel. These 6.7 million barrels of diesel included 3.9 million barrels for use by highway vehicles, and 1.1 million barrels for off-highway machinery and the remainder for industrial uses.

Economics and Taxation

60. Oil and gas revenues rank second among the State's General Fund sources, exceeded only by sales taxes.
61. The petroleum industry is the greatest single source of revenues for the state, its counties, cities, and other political subdivisions.
62. Direct taxes and other direct revenues from the oil and gas industry amounted to $998.6 million in 1981. That was an 894% increase over 1971 when they totaled $100.5 million. (These do not include indirect revenues such as gross receipts taxes on services and material, income and franchise taxes, and ad valorem taxes on plants, pipelines, etc.)
63. The sales value of crude oil produced in New Mexico was $2.449 billion in 1981, an increase of $677 million (37%) over 1980.
64. The sales value of natural gas was $2.335 billion, an increase of $375 million (19%) from the previous year.
65. State assessments on oil and gas production provide about half the money going into the General Fund, which pays the basic costs of government and public education in New Mexico. The petroleum industry supplied an estimated $530 million of the $1.1 billion the General Fund expected from all sources during the fiscal year ending June 30, 1982.
66. Approximately 95% of the State Permanent Fund can be traced to royalties derived from oil and gas. This fund soared to over $1.3 billion in 1981 and distributed $91.3 million to its beneficiaries — primarily schools and other educational institutions.
67. The revenue from oil and gas production accounts for 85% of the Severance Tax Permanent Fund, which reached $602 million in 1981.
68. About $355 million in oil and gas revenues went to schools, colleges, and other educational institutions and agencies during the 1980-81 school year.
69. The Operational Fund for all New Mexico schools totaled $535.9 million in 1980-81, with an estimated 56% of that money coming from oil and gas revenues. The oil and gas share of $297 million more than equaled the salaries of every teacher, and principal in the state, as well as the total expenditures for textbooks and other instructional materials.
70. The State Land Office received more than $355 million in 1981 from royalties, rentals and bonuses paid by the oil and gas industry, compared to $32.6 million in 1971. The beneficiaries of these funds include public schools, State universities and colleges, schools for the deaf and visually handicapped, special hospitals, the penitentiary, State parks and other public projects.
71. New Mexico received $120 million from Federal oil and gas leases in 1981. All of it went to public education.
72. The pump price of gasoline included a 9 cents-per-gallon State tax and a 4 cents-per-gallon Federal tax — a total of 13 cents on each gallon. The State tax will rise to 10¢ in July 1982.
73. State taxes collected on gasoline and special fuels (diesel) totaled $77.8 million in 1981. About 86% of this money ($66.7 million) went to the State Road Fund.

NEW MEXICO OIL & GAS ASSOCIATION
1227 Paseo de Peralta • P.O. Box 1864 • Santa Fe, N.M. 87501
Telephone (505) 982-2568

June 14, 1982

FOR IMMEDIATE RELEASE

NEWS

Contact: Peter Hanagan
Maurice Trimmer
Santa Fe 982-2568

NEW MEXICO RECEIVED $114 THOUSAND AN HOUR FROM OIL AND GAS IN 1981

SANTA FE —New Mexico received an estimated $998.6 million in 1981 as a result of direct taxes and other direct revenues from oil and gas activities according to studies recently completed by the Association staff. By comparison, the state expects to receive $1.3 billion in general fund revenues this fiscal year.

The $998.6 million averaged out to $2.7 million a day, or $113,997 an hour, and was almost 10 times the $100.5 million the state received from these sources in 1971. Total direct taxes and revenues from 1971 through 1981 have exceeded $3.8 billion ($3,831,104,897).

The $998.6 million total for the year included $375.5 million from the 6 taxes the state assesses directly on the oil and gas industry, and $623.1 million from other sources, such as leases, royalties and earnings from state Permanent Fund investments.

While the rise in taxes and other revenues has been dramatic, oil production continued to decline in 1981 as it has every year since 1969. From 1971 through 1981, oil production decreased 39%. The estimated 1981 decline was 4.2% for a total year's production of 72.2 million barrels. Natural gas production in 1981 was 1.12 trillion cubic feet, a 1.2% decline from 1980. Net gas production decline for the period 1971-1981 was 3.3%. Nevertheless, the number of wells drilled and the footage of hole drilled continue at record pace.

The $998.6 million figure for direct taxes and revenues attributable to the oil and gas industry in 1981 does not include the additional large amounts of indirect taxes on the industry arising from gross receipts tax on goods and services, income and franchise taxes, and property taxes on 46 natural gas processing plants, 7 refineries, 25,000 miles of pipelines and other oil and gas facilities. Nor does it include the taxes paid by the 27,000 people employed in the various segments of the petroleum industry in New Mexico.

The $375.5 million total from the 6 direct taxes imposed on the oil and gas industry (Severance, Emergency School, Conservation, Ad Valorem Production, Ad Valorem Equipment, and Natural Gas Processors) was a $295.5 million (940%) increase from the $36.1 million paid in 1971.

The Severance Tax alone during this period rose from $12.9 million to $196.6 million, an increase of 1,424%. Similarly, the Conservation Tax, which funds the state Energy and Minerals Department, increased from $700 thousand to $8.1 million, a 1,057% increase. Tax growth for the 11-year period also included: Emergency School Tax, $13.2 million to $110.3 million, 736% increase; Ad Valorem Production Tax, $7 million to $45.8 million, 554% increase; Ad Valorem Equipment Tax, $1.4 million to $6.1 million, 336% increase; and Natural Gas Processors Tax, $900 thousand to $8.4 million, 833% increase.

The $623.1 million from direct revenues other than taxes marked an 868% increase over the $64.4 million collected from these sources in 1971. The 3,164% rise in oil and gas lease rentals and bonuses (from $4.7 million to $153.4 million) reflected the growth in exploration and drilling on state-owned lands made possible by higher oil and gas prices in recent years.

Other gains from non-tax sources include: royalty from oil and gas production on state-owned lands, $202 million, an increase of 621%; the state's share of federal royalty from oil and gas production on federal lands, $120.5 million, an increase of 939%; earnings on Permanent Fund investments, $110 million, an increase of 447%; and earnings on the Severance Tax Fund, $37.2 million. This fund is only 5 years old so there is no comparable 1971 figure. The attached table contains additional details.

The petroleum industry is the state's greatest single source of tax revenues and ranks 2nd in the state's general fund revenue sources, exceeded only by gross receipts (sales) taxes. New Mexico ranks 4th in the nation in natural gas production and 7th in oil production.

According to Peter Hanagan, the statistical compilation was derived from the records of various public agencies such as the Oil and Gas Accounting Division, Oil Conservation Division, the State Land Office, the Department of Finance and Administration, the State Investment Council, and the State Treasurer's Office.

Attachment

******

During the 15 minutes it may take to read this news release, the state gained another $28,499 in oil and gas revenues.

Comparison of 1971 and 1980 Oil/Gas Revenues with 1981
$ Figures Rounded — Calendar Years

Production Taxes*	1971	1980	1981	% Increase 80-81	% Increase 71-81
Severance	$ 12.9 million	$149.1 million	$196.6 million	32%	1,424%
Emergency School	11.3 million	86.3 million	110.3 million	28%	736%
Conservation	.7 million	6.4 million	8.1 million	27%	1,057%
Ad Valorem Production	9.0 million	41.5 million	65.8 million	59%	554%
Ad Valorem Equipment	1.4 million	5.5 million	6.1 million	11%	336%
Natural Gas Processing	.9 million	6.7 million	8.4 million	25%	833%
Total Production Taxes	$ 36.1 million	$295.5 million	$371.5 million	27%	940%
Other Revenues					
Rentals & Bonuses	$ 4.7 million	$ 85.5 million	$153.4 million	79%	2,344%
Royalty	28.0 million	144.8 million	282.0 million	95%	621%
Permanent Fund Earnings	38.1 million	78.7 million	118.8 million	51%	212%
Federal Mineral Leases	11.8 million	108.1 million	129.5 million	20%	998%
Severance Fund Earnings	-----	21.3 million	27.2 million	27%	
Total Other Revenues	$ 86.6 million	$414.4 million	$651.1 million	58%	868%
GRAND TOTAL	$122.5 million	$709.9 million	$1022.6 million	44%	835%

* Direct taxes on production do not include indirect taxes paid by the industry, such as (1) Gross Receipts Taxes on severance and municipal, (2) Income and Franchise Taxes, and (3) Ad Valorem Taxes on plants, pipelines and other facilities.

Sources: Oil Conservation Division, Oil and Gas Accounting Division, State Land Office, State Treasurer's Office, State Investment Council, and Department of Finance and Administration.

NEW MEXICO OIL & GAS ASSOCIATION
512 Webber • P.O. Box 1864 • Santa Fe, N.M. 87501
Telephone (505) 982-2568

May 27, 1982

FOR IMMEDIATE RELEASE

NEWS

Contact: Peter Hanagan
Maurice Trimmer
982-2568

OIL AND GAS INDUSTRY PAYS HALF OF NEW MEXICO SCHOOL COSTS

SANTA FE — More than half of the Operational Fund for New Mexico's public schools, grades 1-12, came from assessments on the oil and gas industry in fiscal 1980-81.

A recent study by the New Mexico Oil & Gas Association found that the Operational Fund for all New Mexico schools amounted to $535.9 million. About $296.9 million -- or 55 percent — was derived from oil and gas sources.

The public schools' share from oil and gas was more than enough to pay the salaries of every principal, teacher, teacher's aide, and substitute teacher in every district in the state, as well as to provide textbooks and other instructional materials, according to Peter Hanagan, Executive Vice President of the Oil & Gas Association.

Hanagan said the public schools' share averaged $1,184 per student, compared to $912.50 the previous year — a 30 percent increase.

The total amount contributed to public education from oil and gas revenues during 1980-81 came to $354,813,817. That included the $299,792,953 for public schools from elementary through high school, $43,885,586 for the state's colleges and universities, and $11,135,278 for other educational institutions and agencies.

All 89 school districts received money from oil and gas revenues even though 95 percent of the petroleum produced in New Mexico comes from only 4 counties, Hanagan noted. The Albuquerque school district received the most, $87,173,781; followed by Las Cruces, $15,727,997; and Santa Fe, $12,551,368. None of these districts produces any oil or gas. 48 school districts received more than a million dollars each. (See attached list.)

The allocations for state colleges and universities included: University of New Mexico, $17,474,451; New Mexico State University, $12,435,242; New Mexico Military Institute, $4,284,226; N.M. Eastern University, $4,943,566; N.M. Institute of Mining and Technology, $1,678,272; N.M. Highlands University, $1,795,539; and N.M. Western University, $1,274,490.

The School for the Deaf in Santa Fe received $2,768,366, and the School for the Visually Handicapped in Alamogordo received $2,492,692.

Smaller amounts went to the Northern N.M. Community College in El Rito-Espanola, $1,246,366; Albuquerque Technical-Vocational Institute, $1,640,986; Luna Area Vocational School in Las Vegas, $313,472; New Mexico Junior College, $255,000; Tucumcari Area Vocational School, $73,150; and in Santa Fe, the Office of Cultural Affairs, $994,401; The Department of Education, $575,102; the Division of Vocational Rehabilitation, $686,563; the Board of Educational Finance, $62,932; and the Legislative Education Study Committee, $26,248.

The figures in the financial report are "conservative," Hanagan said. "They do not include income taxes from corporations and individuals associated with the industry since that is confidential information. Nor is there any way to measure the overall impact the industry makes on New Mexico's general economic growth."

Petroleum-related revenues going to education include income from State Permanent Fund investments, bonuses and rentals collected by the State Land Office, the state's share of federal mineral lease funds, the Oil and Gas School Tax, Conservation Tax, Processors Tax, Gross Receipts Tax, and Severance Tax, and the district property tax levies on oil and gas valuations.

Basic statistical information for the Association's report was obtained from the State Department of Finance and Administration, State Land Office, the Department of Taxation and Revenue, the Board of Educational Finance, and the State Investment Division.

NEW MEXICO OIL & GAS ASSOCIATION

Attachment to News Release of May 27, 1982

School districts which received at least $1 million from oil-gas revenue sources during 1980-1981 school year.

1.	Alamogordo	$ 7,102,392	25.	Las Cruces	$15,727,997
2.	Albuquerque	87,173,781	26.	Las Vegas City	2,768,004
3.	Artesia	4,815,905	27.	Las Vegas Town	2,937,187
4.	Aztec	4,907,237	28.	Lordsburg	1,164,238
5.	Belen	4,003,108	29.	Los Alamos	3,470,137
6.	Bernalillo	2,677,340	30.	Los Lunas	3,626,188
7.	Bloomfield	5,015,183	31.	Lovington	4,587,743
8.	Carlsbad	7,512,197	32.	Mora	1,093,918
9.	Central Consol.	1,964,705	33.	Moriarty	1,398,952
10.	Chama	1,144,099	34.	Pojoaque	1,512,654
11.	Clayton	1,057,074	35.	Portales	2,957,346
12.	Clovis	8,506,847	36.	Raton	2,214,030
13.	Cobre Consol.	2,550,561	37.	Roswell	10,605,546
14.	Deming	3,829,394	38.	Ruidoso	1,451,072
15.	Espanola	6,259,370	39.	Santa Fe	12,551,368
16.	Eunice	2,951,048	40.	Santa Rosa	1,205,278
17.	Farmington	8,956,941	41.	Silver City	4,329,235
18.	Gadsden	6,185,416	42.	Socorro	2,228,720
19.	Gallup	6,649,477	43.	Taos	4,316,831
20.	Grants	4,616,722	44	Tatum	1,280,373
21.	Hatch	1,138,481	45.	T or C	1,554,622
22.	Hobbs	9,624,214	46.	Tucumcari	2,174,433
23.	Jal	1,396,088	47.	Tularosa	1,434,324
24.	Jemez Mtn.	1,452,939	48.	Zuni	1,834,958

TABLE C

Distributions to Universities and Colleges -- 1980-1981

Institution	General Fund	Permanent Fund Income	Land Income	Severance Tax Bonding Fund	Totals
University of New Mexico*	$ 10,045,018	$ 1,753,744	$ 2,502,469	$ 3,173,220	$ 17,474,451
New Mexico State University*	6,617,275	465,096	1,621,966	3,730,905	12,435,242
N.M. Highlands University	1,302,833		322,506	170,000	1,795,339
N.M. Western University	694,956		329,485	250,049	1,274,490
N.M. Eastern University*	2,631,478	69,406	1,446,912	795,770	4,943,566
N.M. Institute of Mining & Technology	911,767	171,333	170,172	425,000	1,678,272
N.M. Military Institute	94,061	2,905,698	831,587	452,880	4,284,226
TOTALS	$ 22,297,388	$ 5,365,277	$ 7,225,097	$ 8,997,824	$ 43,885,586

*Includes branch campuses.

TABLE D

Distributions to Other Educational Institutions and Agencies — 1980-1981

Institution or Agency	General Fund	Permanent Fund Income	Land Income	Severance Tax Bonding Fund	Totals
Northern N.M. Community College	$ 548,755		$ 303,721	$ 393,890	$ 1,246,366
Tech'l.-Voc'l. Institute (Albuquerque)	1,640,986				1,640,986
Luna Area Voc'l. School	313,472				313,472
Tuc. Area Voc'l. School	73,150				73,150
N.M. School for the Deaf	305,437	2,067,030	395,899		2,768,366
N.M. School for the Visually Handicapped	41,664	2,055,711	395,317		2,492,692
Legislative School Study Committee	26,248				26,248
Department of Education	575,102				575,102
Division of Vocational Rehabilitation	686,563				686,563
Board of Educational Finance	62,932				62,932
Office of Cultural Affairs*	994,401				994,401
N.M. Junior College				255,000	255,000
TOTALS	$ 5,268,710	$ 4,122,741	1,094,937	$ 648,890	$ 11,135,278

*Includes Museum, State Libraries, Space Hall of Fame and Planetarium, Laboratory of Anthropology, 9 monuments.

1981 CROP SUMMARY — Acres Harvested, Yield per Acre, Value of Production

CROP	Acres Harvested (thousands)	Unit	Yield Per Acre	Production (thousands)	Value of Production (thousands)
Corn, Grain	75	Bu.	120	9,000	$ 25,200
Wheat, Winter	500	Bu.	21	9,000	33,300
Barley	28	Bu.	67	1,876	4,690
Sorghum Grain	272	Bu.	45	12,240	30,845
Cotton Lint:					
Upland	105	Lb.	549	120 *	34,560
American-Pima	6.9	Lb.	480	6.9*	3,378
Cottonseed	—	Ton	—	49.7	4,423
All Hay	315	Ton	4	1,256	104,248
Alfalfa	240	Ton	4.7	1,128	—
Peanuts	9.5	Lb.	2,450	23,275	6,284
Potatoes	4.5	Cwt.	210	945	6,143
Apples, Commercial Crop	—	Lb.	—	17,000	2,346
Pecans	—	Lb.	—	19,000	16,150
Commercial Vegetables:					
Lettuce	3.4	Cwt.	460	741	7,695
Onions	3.6	Cwt.	345	1,242	20,120
Chile Peppers, All Varieties	15.3	Ton	1.5	23.6	29,146
TOTAL VALUE OF PRODUCTION					$328,528

*480-pound net weight bales. Production ginned and to be ginned.

ACRES HARVESTED — 1980 & 1981
(in thousands)

CROP	1980	1981	CROP	1980	1981
All Hay	310	315	Peanuts	8.8	9.5
Sorghum	286	302	Chile Peppers	17.2	15.3
Wheat	500	500	Lettuce	3.5	3.4
Corn	112	98	Onions	3.9	3.6
Cotton	127	111.9	Potatoes	3.0	4.5
Barley	35	28	Sugarbeets	1.6	2.1
TOTAL ACRES OF ALL CROPS HARVESTED				1,408.0	1,393.3

MILK PRODUCTION — 1980 & 1981

	1980	1981
Milk Cows on Farms	45,000	51,000
Milk Production (lbs.)	602,000,000	670,000,000
Milk Per Cow (lbs.)	13,378	13,137

Source: New Mexico Department of Agriculture

(From New Mexico Progress, 1981 Economic Report, Volume 49)

LIVESTOCK PRICES 1977-1981

Prices to Farmers (annual average)	1977	1978	1979	1980	1981[1]
All Beef Cattle (per cwt.)	$37.83	$51.20	$69.03	$64.30	$51.00
Calves (per cwt.)	33.57	56.43	86.94	77.60	67.10
Sheep (per cwt.)	13.28	19.74	26.54	22.60	22.70
Lambs (per cwt.)	52.48	66.46	71.81	61.90	51.00
Wool (per lb.)	.69	.72	.86	.90	1.06

[1]Subject to Revision

LIVESTOCK ON NEW MEXICO FARMS — 1980 & 1981

	Number (in thousands)			Value (in thousands)		
	1980	1981	% Change	1980	1981	% Change
Cattle & Calves	1,600	1,400	−12.5	$664,000	$560,000	−15.7
Sheep & Lambs	660	650	− 1.5	50,820	40,625	−20.1
Hogs & Pigs	74	62	−16.2	4,588	4,588	—
Chickens	2,145	1,825	−14.9	3,647	3,559	− 2.4
TOTAL VALUE				$723,055	$608,772	−15.8

CATTLE SHIPMENT & SLAUGHTER — 1980 & 1981

CATTLE SHIPMENT (head)	1980	1981
Cattle shipped into New Mexico	654,063	483,228
Cattle shipped out of New Mexico	1,125,318	994,872
Cattle received at Clovis Auction	156,113	100,725
COMMERCIAL LIVESTOCK SLAUGHTER (head)	**1980**	**1981**
Cattle	429,100	165,300
Hogs	43,000	38,700
Sheep & Lambs	89,800	86,500
TOTAL	561,900	290,500

Source: New Mexico Department of Agriculture

(From New Mexico Progress, 1981 Economic Report, Volume 49)

MINERAL PRODUCTION IN NEW MEXICO[1]

Mineral	1980 Quantity	1980 Value (thousands)	1981[P] Quantity	1981[P] Value (thousands)
Clays[2] (thousand short tons)	60	$ 114	35	$ 75
Coal, bituminous (thousand short tons)	17,303[4]	249,930[4]	21,500[5]	360,356[R]
Copper[3] (metric tons)	149,394	337,328	154,000	288,000
Gold[3] (troy ounces)	15,787	9,670	51,000	23,800
Gypsum (thousand short tons)	102	1,608	177	1,707
Manganiferous ore (5% to 35% Mn) (short tons)	35,196	W	W	W
Natural gas (million cubic feet)	1,097,245[5]	1,975,199[6]	1,080,760[5]	2,332,617[6]
Natural gas liquids (thousand 42-gallon barrels)	43,003	1,035,939[7]	53,867	1,847,107[7]
Peat (thousand short tons)	2	40	2	42
Perlite (thousand short tons)	539	14,404	463	14,498
Petroleum (crude) (thousand 42-gallon barrels)	75,118[5]	1,799,074[6]	71,415[5]	2,449,044[R]
Potassium salts (thousand metric tons)	1,869	289,011	1,820	290,000
Pumice (thousand short tons)	448	3,028	450	2,999
Sand and gravel (thousand short tons)	7,050	17,676	7,200	18,000
Stone (thousand short tons)	2,235	7,350	2,475	8,439
Uranium (U_3O_8) (thousand pounds)	14,483[4]	371,018[4]	9,077	285,029
Combined value of barite, carbon dioxide, cement (portland and masonry), fire clay, helium (high purity) (1980), gem stones, lead, lime, molybdenum, silver, salt, vanadium, zinc, and items indicated by symbol W	XX	87,995[R]	XX	79,503
TOTAL	XX	$6,199,464[R]	XX	$8,001,216

P — Preliminary. W — Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. R — Revised. XX — Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes fire clay; value included in "Combined value" figure.
[3]Recoverable content of ores, etc.
[4]1980 figures have been adjusted to reflect severance tax data rather than resource excise tax as previously reported.
[5]Quantity represents marketed production rather than actual volumes severed/produced.
[6]Value represents sales from marketed production.
[7]Values are based upon the average price per barrel of natural gas liquids. (1980 — $24.09; 1981 — $34.29)
Source: U.S. Bureau of Mines and New Mexico Energy and Minerals Department.

(From New Mexico Progress, 1981 Economic Report, Volume 49)

Peter Hanagan
Maurice Trimmer
New Mexico Oil & Gas Assn.
Santa Fe (505) 982-2568

NEW MEXICO

1980 AND 1981 OIL AND GAS PRODUCTION AND VALUE

Production and Value	1980 Total	1981 Total*	% Increase or (Decrease)
Oil Production (bbls.)	75,323,665	72,155,017	(4.2%)
Natural Gas Production (MCF)	1,132,316,440	1,118,588,587	(1.2%)
Sales Value of Oil Prod.	$1,782,454,147	$2,449,044,083	37.4%
Sales Value of Nat. Gas Prod.	1,958,007,625	2,332,617,297	19.1%
Total Sales Value O & G	$3,740,461,722	$4,781,661,381	27.8%
Less Royalties (state, federal, Indian)	359,415,364	457,935,333	27.4%
Total Sales Value Less Royalties	$3,381,046,408	$4,323,726,048	27.8%

New Mexico Oil & Gas Association
Peter Hanagan
Maurice Trimmer
Santa Fe 982-2568

OIL AND GAS SHARE OF RECURRING GENERAL FUND REVENUES

Revenue Source	1980-1981 FY	Estimated 1981-1982 FY	Percentage Increase or (Decrease)
Emergency School Tax	$ 94,249,580	$ 112,000,000	18.8%
7% of Conservation Tax	486,000	540,000	11.1%
Natural Gas Processors Tax	7,359,420	9,200,000	25.0%
Federal Mineral Lease	102,768,150	136,135,000	32.5%
Land Office Income for Schools	73,177,600	91,710,000	25.3%
Permanent Fund Income for Schools	73,611,700	96,900,000	31.6%
Severance Tax Permanent Fund Income	27,236,800	42,880,000	57.4%
Property Tax (2.85 mills)	461,600	N/A*	
Gross Receipts Tax **	28,832,320	23,100,000	(19.9%)
Compensating Tax **	2,020,960	3,000,000	48.4%
Corporate Income Tax **	11,337,920	14,000,000	23.5%
Total Oil and Gas Share	$422,639,891	$ 529,465,000	25.3%
Total General Fund Revenues	$1,046,348,000	$1,100,400,000	5.2%
Oil and Gas Percentage of Total General Fund Revenues	40.4%	48.1%	

* 1981 legislation eliminated the State share of the property tax.

** The oil and gas share is based on estimates by the Taxation and Revenue Department.

12-15-81

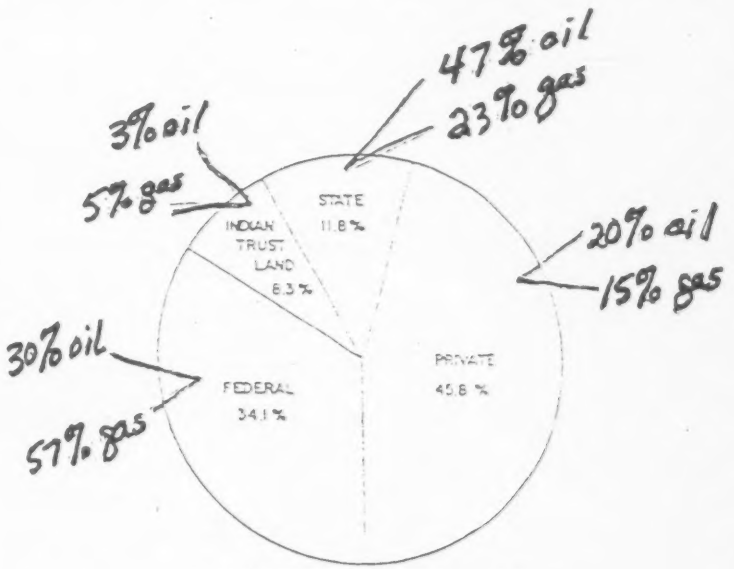
1982

OWNERSHIP OF LANDS IN NEW MEXICO

New Mexico, the fifth largest State in the nation, contains some 77,766,399 acres or approximately 121,510 square miles. This land is divided into four principal types of ownership as follows:

Privately Owned Lands	35,637,251 acres
Federal Government	26,457,467 acres
Indian Trust Lands	6,454,611 acres
State Trust Lands	
Surface	9,217,070 acres
Mineral Rights	13,104,357 acres

The State Trust Lands consist of more than 9.2 million acres of land surface and approximately 13 million acres of mineral rights. The surface and mineral rights are held in trust for the following beneficiary institutions: Common Schools, University of New Mexico (includes Saline Lands), Western New Mexico University, New Mexico Highlands University, New Mexico State University, Northern New Mexico Community College, Eastern New Mexico University, New Mexico Institute of Mining and Technology, New Mexico Military Institute, New Mexico Boys' School, Miners' Hospital, State Hospital, State Penitentiary, School for the Deaf, School for the Visually Handicapped, Carrie Tingley Hospital, Charitable, Penal and Reform, Water Resources, and Rio Grande Improvements. In accordance with Sections 19-10-50 and 19-10-51, 1978 NMSA, the State Land Office is also charged with the responsibility of administering and leasing for oil and gas and other minerals, the subsurface estate of certain lands owned by the State Park Commission.



LAND OWNERSHIP IN NEW MEXICO

March 1982

RESUME: PETER HANAGAN

Peter Hanagan has served as Executive Vice President of New Mexico Oil & Gas Association since 1970. Prior to that he practiced law for thirteen years in Washington, D. C., where he also taught Business Law at American University.

A native of Roswell, Hanagan received a B.S. degree from Georgetown University, Washington, D. C., where he also completed course work for an M.A. in Political Science. He holds a Juris Doctor (J.D.) from George Washington University, Washington, D. C.

Hanagan is a member of various bars including the U.S. Supreme Court, the N.M. Supreme Court, the U.S. Courts of Appeal in Denver and Washington, The U.S. Tax Court, Court of Military Appeal, and the Bar Associations of New Mexico, Santa Fe, and the District of Columbia. He serves on a number of federal and state government committees dealing with oil and gas, water, environment, and land management.

Spring 1982

PETER HANAGAN

MEMBERSHIPS

CURRENT

BUREAU OF LAND MANAGEMENT, DISTRICT ADVISORY COUNCIL
N. M. STATE LAND OFFICE, COMMISSIONER OF PUBLIC LANDS ADVISORY BOARD
N. M. DEPARTMENT OF TAXATION AND REVENUE, MUNICIPAL TAX ADVISORY COMMITTEE
N. M. ENVIRONMENTAL IMPROVEMENT DEPARTMENT, OCCUPATIONAL HEALTH AND SAFETY TECHNICAL ADVISORY COMMITTEE
N. M. ENVIRONMENTAL IMPROVEMENT DEPARTMENT, AIR QUALITY TECHNICAL ADVISORY COMMITTEE
N. M. STATE WATER RESOURCES INSTITUTE, ADVISORY COMMITTEE
ROCKY MOUNTAIN MINERAL LAW FOUNDATION

PREVIOUS

BUREAU OF LAND MANAGEMENT, CHAIRMAN N. M. STATE ADVISORY BOARD
N. M. WATER QUALITY COMMISSION, ADVISORY COMMITTEE
REGIONAL ENVIRONMENTAL EDUCATION RESEARCH AND IMPROVEMENT ORGANIZATION, (REERIO), BOARD OF DIRECTORS
INTERSTATE OIL COMPACT COMMISSION, REGULATORY PRACTICES COMMITTEE
FEDERATION OF ROCKY MOUNTAIN STATES, NATURAL RESOURCES COUNCIL, LAND USE COMMITTEE
GOVERNOR'S ENERGY TASK FORCE, ALTERNATE MEMBER
GOVERNOR'S COMMITTEE ON N. M. ENERGY USE

N. M. PRESS ASSOCIATION

NATIONAL PRESS CLUB, WASHINGTON, D. C. (INACTIVE)
N. M. AMIGOS
ALBUQUERQUE PETROLEUM CLUB
WHO'S WHO IN THE WEST

U. S. SUPREME COURT BAR
N. M. SUPREME COURT BAR
U. S. COURT OF APPEALS, DISTRICT OF COLUMBIA CIRCUIT
U. S. COURT OF APPEALS, 10TH CIRCUIT (DENVER)
U. S. DISTRICT COURT, DISTRICT OF COLUMBIA
U. S. TAX COURT
U. S. COURT OF MILITARY APPEALS
U. S. COURT OF CUSTOMS AND PATENT APPEALS
U. S. COURT OF CLAIMS
DISTRICT OF COLUMBIA BAR ASSOCIATION
N. M. BAR ASSOCIATION
SANTA FE COUNTY BAR ASSOCIATION

Mr. SKEEN. Thank you very much. I appreciate your testimony. Now, we will go to you, Mr. Martin.

Mr. MARTIN. I appreciate the opportunity to appear and to testify before the committee on the effect of the energy exploration and development in this area.

I am Jerry Don Martin, president of the local Fee and Public Land Users Association. I am a full-time rancher living north of Roswell. My granddad moved to this area in 1914, and my family has been raising cattle since then. I have been involved with agriculture in this area all of my life.

The exploration and development of energy in this area has caused many new problems to arise for livestock producers. One of these problems is the increased personnel and vehicles moving through the ranches. This causes the livestock to quit eating grass and follow each vehicle. We feed supplement from our pickups, and the livestock think someone is going to give them some more feed. As a result, the cattle need more feed, put on less weight, which causes breeding problems. Cattle following vehicles excessively can also cause surface terrain damage.

I am a cow-calf-yearling rancher. When I remove the calves from their mothers at 6–8 months of age, they are put into another pasture for 1 year. At the end of the year, they are sold or go into a feedlot to fatten for beef. My yearlings normally put on 300 pounds each from the time they are removed from their mothers until they are sold.

Frequent vehicles through their pasture throughout the year will easily cut their average gain down to 200 pounds. This loss of 100 pounds per animal times the 400 head I normally run, amounts to 40,000 pounds, or approximately $24,000, out of any profit I hope to make.

I have had to hire another man to help me on the ranch to keep the gates closed and check on all unknown vehicles and tracks running through the ranch to protect my cattle and property. This is an additional cost of operating my ranch in excess of $20,000 a year. Last year, I lost four cows and one bull to thieves out of one pasture. This is a loss of over $4,000.

The dust from the dirt roads and the drilling rigs gets so bad and settles out on the grass for hundreds of yards in all directions, that the cattle will not graze in that area. This leads to weight loss and overgrazing in other areas of the pasture. The baby calves also get separated from their mothers by so many other people and vehicles traveling across their pasture, causing deaths of our "doggies," which the rancher has to raise by bottle.

The county roads that are used by the oil and gas industry were meant for very limited travel. They are now used by scores of heavy trucks and pickups, until they are nearly impassable. On a road where it used to take 1½ hours to get to the sales ring, it now takes 4 to 5 hours. This results in more weight loss and less money for the rancher. It also makes the cattle more prone to various kinds of sickness causing the buyer to pay less.

Visualize, if you will, an example of the financial loss of calves—400 head—at 450 pounds each, leaving a ranch for town. If these trucks are delayed for just a few hours, such as getting stuck in a

mudhole, or holes in the road, the weight loss to these calves can easily be 10 percent or 45 pounds to each animal.

At today's prices, at an average of 65 cents per pound, this would come to approximately $12,000 loss by just one rancher. Since these roads serve several ranches, these losses could be multiplied several times. The same would apply for sheep, because anytime livestock are hauled by trucks, they start losing weight.

Since a rancher's income is seasonal, and the major portion comes during the fall, these losses could result in a financial deficit for an entire year's labor.

Children living on ranches attend school in Roswell. Transportation is either by bus, or cars to meet buses, which requires that we have all-weather roads. Where these roads have deteriorated to their current condition of numerous chuck, potholes, and ruts, it makes for hazardous and expensive travel. The more travel there is on a road, the more difficult it is to maintain. In the winter, if it snows, it is almost impossible to travel because of the deep ruts. When it rains, the water cannot run off the road because of the holes and it just stands there and then causes erosion.

Highway U.S. 285 north of Roswell was resealed in the fall of 1981. The numerous excessive heavy loads carried over this surface has already caused many, many cracks in excess of 1 inch. This will cost the taxpayer many dollars in the future to replace or repair this highway.

Another severe problem is the effect of energy development on the wildlife of this area. With the wide-open spaces and good weather in this section, wildlife thrives, resulting in many pleasurable hours of watching, hunting, photographing, and painting of the magnificent area views. The increased travel in the area causes loss of offspring when they are born. There has been a large increase in poaching and general harassment of wildlife. The energy development also causes loss of critical habitat for all kinds of wildlife.

Another negative aspect that has been brought about by the oil and gas boom is the increase in range fires. In the approximately 50 miles of pavement north of Roswell that I am familiar with, there have been 14 fires this year. Before, there was maybe one or two a year. These fires constitute a severe danger to the agriculture industry, wildlife, and personal property and to the untrained people who have to fight the fires. It also causes a problem in the neighboring towns by tying up fire equipment from far away for many hours.

One fire east of Roswell reportedly was in excess of 30,000 acres. This can cost more than $750 per day to feed the livestock that lost their forage in the fire, not to mention the loss of life and habitat to wildlife. The rancher might have to sell his stock and, if at the time the prices are depressed, then this is a bigger loss. It also takes many years to replace forage damaged by fires.

In this area the Federal, State, and private lands are intermingled to the extent that ranchers receive little or no compensation for the damage done by oil and gas development as most of the mineral rights on private land have been retained by the Federal or State governments. As a matter of fact, less than 25 percent of the mineral rights are owned by the ranchers.

99-979 O - 82 - 8

Another item that I would like to mention is the inheritance tax that has to be paid on leased land. Upon the death of a rancher, the Federal Government charges inheritance tax to his family on both State and Federal lands that he has under lease. They receive no compensation for loss of income due to harassment of livestock or damage to the land by the oil and gas development, but they have to pay inheritance tax on land they do not even own. This seems a little unfair.

The energy development has helped the area in location and development of water resources. It has brought many new businesses and jobs into Roswell. Some of these businesses make readily available products and services that one would otherwise have to go many miles to get.

We like the energy development in this area and all of the United States so that we are not dependent upon foreign supplies. It is better to develop our own resources and to provide employment at home. Please, not at the expense of the food and fiber industry.

As the population increases, we need the great ability of the American agriculture to feed and clothe its people. We would like to see more consideration of the energy development people to the road systems, land and water usage, and reclamation of drilling sites and roads. One way to do this and keep agriculture strong without a costly Federal program is for the rancher to get one-eighth to one-fourth percent of the royalty from wells drilled on Federal- and State-owned minerals. The rancher is experienced on the land and knows better what reclamation work is in his area. He has the incentive to do the work for the betterment of his business and could do it with the royalty percentage.

Mr. SKEEN. Human energy resulting from food and fiber of the agriculture industry is the most important energy there is.

Thank you.

[The prepared statement of Mr. Martin follows:]

STATEMENT OF JERRY DON MARTIN

I appreciate the opportunity to appear and to testify before the Committee on the "Effect of the energy exploration and development in this area".

I am Jerry Don Martin, President of the local "Fee and Public Land Users Association." I am fulltime rancher living north of Roswell. My grandad moved to this area in 1914 and my family has been raising cattle since then. I have been involved with agriculture in this area all of my life.

The exploration and development of energy in this area has caused many new problems to arise for livestock producers.

One of these problems is the increased personnel and vehicles moving through the ranches. This causes the livestock to quit eating grass and follow each vehicle. We feed supplement from our pickups and the livestock think someone is going to give them some more feed. As a result, the cattle need more feed, put on less weight, which causes breeding problems. Cattle following vehicles excessively can also cause surface terrain damage.

I am a cow-calf-yearling rancher. When I remove the calves from their mothers at 6–8 months of age, they are put into another pasture for one year. At the end of the year they are sold or go into a feedlot to fatten for beef. My yearlings normally put on 300 pounds each from the time they are removed from their mothers until they are sold. Frequent vehicles through their pasture throughout the year will easily cut their average gain down to 200 pounds. This loss of 100 pounds per animal times the 400 head I normally run, amounts to 40,000 pounds, or approximately $24,000, out of any profit I hope to make.

I have had to hire another man to help me on the ranch to keep the gates closed and check on all unknown vehicles and tracks running through the ranch to protect my cattle and property. This is an additional cost of operating my ranch in excess of $20,000 a year. Last year I lost four cows and one bull to thieves out of ONE pasture. This is a loss of over $4,000.

The dust from the dirt roads and the drilling rigs gets so bad and settles out on the grass for hundreds of yards in all directions, that the cattle will not graze in that area. This leads to weight loss and overgrazing in other areas of the pasture. The baby calves also get separated from their mothers by so many other people and vehicles traveling across their pasture, causing deaths of our "doggies" which the rancher has to raise by bottle.

The county roads that are used by the oil and gas industry were meant for very limited travel. They are now used by scores of heavy trucks and pickups, until they are nearly impassable. On a road that it used to take a hour and a half to get to the salesring, it now takes four to five hours. This results in more weight loss and less money for the rancher. It also makes the cattle more prone to various kinds of sickness causing the buyer to pay less.

Visualize, if you will, an example of the financial loss of calves (400 head) at 450 pounds each, leaving a ranch for town. If these trucks are delayed for just a few hours, such as—getting stuck in a mud hole, or holes in the road—the weight loss to these calves can easily be 10 per cent or 45 pounds to each animal. At today's prices, at an average of 65 cents per pound, this would come to approximately $12,000 loss by just one rancher. Since these roads serve several ranches, these losses could be multipled several times. The same would apply for sheep, because anytime livestock are hauled by trucks they start losing weight.

Since rancher's income is seasonal and the major portion comes during the fall, these losses could result in a financial deficit for an entire year's labor.

Children living on ranches attend school in Roswell. Transportation is either by bus or cars to meet buses which requires that we have all-weather roads. Where these roads have deteriorated to their current condition of numerous chuck, pot holes and ruts, it makes for hazardous and expensive travel. The more travel there is on a road, the more difficult it is to maintain. In the winter, if it snows, it is almost impossible to travel because of the deep ruts. When it rains, the water cannot run off the road because of the holes and it just stands there and then causes erosion.

Highway U.S. 285 north of Roswell was resealed in the fall of 1981. The numerous excessive heavy loads carried over this surface has already caused many, many cracks in excess of one inch. This will cost the taxpayer many dollars in the future to replace or repair this highway.

Another severe problem, is the effect of energy development on the wildlife of this area. With the wide open spaces and good weather in this section, wildlife thrives, resulting in many pleasurable hours of watching, hunting, photographing, and painting of the magnificent area views. The increased travel in the area causes loss of offspring when they are born. There has been a large increase in poaching and general harassment of wildlife. The energy development also causes loss of critical habitat for all kinds of wildlife.

Another negative aspect that has been brought about by the oil and gas boom, is the increase in range fires. In the approximately fifty miles of pavement north of Roswell that I am familiar with, there has been fourteen fires this year. Before, there was maybe one or two a year. These fires constitute a severe danger to the agriculture industry, wildlife, and personal property and to the untrained people who have to fight the fires. It also causes a problem in the neighboring towns by tying up fire equipment from far away for many hours. One fire east of Roswell reportedly was in excess of 30,000 acreas. This can cost more than $750 per day to feed the livestock that lost their forage in the fire, not to mention the loss of life and habitat to wildlife. The rancher might have to sell his stock, and if at the time the prices are depressed, then this is a bigger loss. It also takes many years to replace forage damaged by fires.

In this area the federal, state and private lands are intermingled to the extent that ranchers receive little or no compensation for the damage done by oil and gas development as most of the mineral rights on private land have been retained by the federal or state governments. As a matter of fact, less than 25 per cent of the mineral rights are owned by the ranchers.

Another item that I would like to mention is inheritance tax that has to be paid on leased land. Upon the death of a rancher the federal government charges inheritance tax to his family on both state and federal lands that he has under lease. They receive no compensation for loss of income due to harassment of livestock or

damage to the land by the oil and gas development, but they have to pay inheritance tax on land they do not even own. This seems a little unfair.

The energy development has helped the area in location and development of water resources. It has brought many new business and jobs into Roswell. Some of these businesses make ready available products and services that one would otherwise have to go many miles to get.

We like the energy development in this area and all of the United States, so that we are not dependent upon foreign supplies. It is better to develop our own resources and to provide employment at home. PLEASE not at the expense of the food and fiber industry.

As the population increases, we need the great ability of the American Agriculture to feed and clothe its people. We would like to see more consideration of the energy development people to the road systems, land and water usage, and reclamation of drilling sites and roads. One say to do this and keep agriculture strong without a costly federal program, is for the rancher to get ⅛ to ¼ percent of the royalty from wells drilled on federal and state owned minerals. The rancher is experienced on the land and knows better what reclamation work in his area. He has the incentive to do the work for the betterment of his business and could do it with the royalty percentage.

BIOGRAPHICAL SKETCH OF JERRY DON MARTIN

Native of Roswell, New Mexico. Has lived and worked in this area all of his 44 years.

Attended elementary school in Dunlap, a small one room school house. Graduate of NMMI (New Mexico Military Institute) High School, attended New Mexico State University two years.

Has been involved in several community activities including: President, Fee and Public Land Users Association. Member of; New Mexico Farm and Livestock Bureau, National Rifle Association; National Skeet Shooters Association, and Southeastern New Mexico Grazing Association.

Jerry Don and his wife, Waneta; live on the ranch with their two daughters. Shellie, twenty-two and Janie eighteen years old.

Mr. SKEEN. Thank you very much, Mr. Martin.

Mr. Turpen.

Mr. TURPEN. Mr. Chairman, staff, ladies and gentlemen, I am Charles Turpen, Secretary of the New Mexico Energy and Minerals Department. It is indeed a pleasure and an honor to be here today to testify before your subcommittee. I am certain these hearings will be of benefit to everybody here today and will give you some ideas for policy direction and guidelines.

The State of New Mexico believes the topic for this hearing, "The Natural Gas Option—New Resources and New Technologies," is of vast importance to the State and the rest of the country. This, of course, is because New Mexico is a major producer as well as consumer of natural gas.

The oil and gas industry—which in 1980 alone provided 24,300 jobs and direct revenues of $709.8 million to the State—has played an extremely important role in the State's economy. However, these facts also indicate that the State plays a major role in helping to meet the Nation's energy needs through its production of natural gas. In this regard, Mr. Chairman, it should be noted that New Mexico ranks fourth in the Nation in natural gas reserves and fourth in the production of natural gas.

With the number of jobs and revenues generated by the natural gas industry in the State and with almost 90 percent of the State's production being primarily disposed of in interstate commerce, it is quite easy to realize why a discussion of further developments in the industry is of great interest to us as well as yourselves.

Mr. Chairman, it is my understanding that for this hearing you are interested in the following information from the State:

One. The state-permitting process for recovery of natural gas from unconventional resources, that is, tight formation gas;

Two. How the State has handled socio-economic impacts from energy development and what the potential future needs in this area might be; and

Three. What we perceive the role the Federal Government should be in providing incentives for this additional natural gas production.

Therefore, my testimony will address these three issues in the above-stated order.

THE STATE PERMITTING PROCESS

Briefly, as you know, the Natural Gas Policy Act of 1978—NGPA—provided increased prices as incentives for the production of natural gas which might not otherwise be produced. One of these incentives is given for the production of gas from tight formations—also known as tight sands, or tight gas.

The oil conservation division of the New Mexico Energy and Minerals Department is the agency responsible for making a recommendation to the Federal Energy Regulatory Commission on the propriety of allowing this price incentive for gas produced from various tight formations. This recommendation is based upon the ability of the formation to meet certain criteria contained in regulations issued under section 107 of the NGPA.

The criteria are outlined in my testimony, and I will not outline them here.

It is sufficient to stress that anyone must develop an application with the required evidence and submit such application to the oil conservation division.

The application and evidence are considered at a public hearing held by the oil conservation commission, which is an independent commission comprised of the commissioner of public lands, the State petroleum engineer, and the State geologist, or one of the oil conservation division's hearing examiners. After the public hearing is held, the division makes its recommendation to the Federal Energy Regulatory Commission. They have approved, so far, eight of our applications.

The State's oil conservation division has received 22 applications for tight formation designation in both the northwestern and southeastern sections of the State. Of these 22 applications, the division has approved 18, submitting its recommendations for approval to the Federal Energy Regulatory Commission. The Commission has approved eight of our recommendations to date. As far as the State process is concerned, only four cases currently remain to be acted upon by division examiners.

The oil conservation division has not denied any cases so far; however, we have limited the area extent of some applications based on evidence in the record. The areas we have approved range in size from 33,500 acres to 1,536,000 acres, with a current total of 2,257,318 acres approved.

Our biggest success story under this program is the Abo tight formation area in Chaves and Debaca Counties. We have had over 600 applications to drill and 400 completions since our approval of this area in February 1981. 1981 production in this area was approximately 7,908,865 Mcf, with cumulative production, to date, at 9,477,949 Mcf.

This "107 gas" production throughout New Mexico presently accounts for approximately 2.5 percent of our total natural gas production. However, with the right incentives and development of new technologies, it is quite possible that our natural gas production from unconventional sources could account for a much greater share of the State's total production in the very near future.

I will turn now to mitigation of socioeconomic impacts.

MITIGATION OF SOCIO-ECONOMIC IMPACTS

I know that Congressman Skeen is particularly interested in the socioeconomic impacts of any increased development of this new natural gas. In this regard, I would like to outline the process we have been working with in New Mexico for the mitigation of such impacts from energy and mineral development.

In our State, we have what is called the community assistance program under the auspices of the New Mexico Community Assistance Council. The New Mexico Community Assistance Council was created under the New Mexico Community Assistance Act of 1977 to administer a grant program of financial assistance "for solving the community problems arising from the rapid growth in areas near the development of mineral and energy resources." Under the community assistance program definition, an eligible grantee must be a political subdivision of the State.

Membership on the council consists of the secretaries of the Energy and Minerals Department, the Health and Environment Department, the Department of Finance and Administration, and the State Planning Division. In addition, five members are appointed by the Governor. Each appointee represents one of the five community assistance councils [CAC] districts.

I have attached a map of the CAC districts to the statement.

Since 1977, legislation enacted annually has provided that financing for needed projects would come from the issuance of severance tax bonds. The only exception to this was in 1978, when moneys were appropriated from our general fund.

Over the past 5 years of the program, a total of $34,475,000 has been appropriated for projects recommended for funding by the council and approved by the State board of finance. For the record, I am attaching a copy of a table which breaks down the funding levels for each year.

In addition, the 1979 New Mexico State Legislature appropriated $500,000 for advanced planning/study grants for CAC-approved projects. Another $150,000 was appropriated in 1981 for the same purpose.

Since the inception of the community assistance program, those areas in the State which are impacted by developments in the oil and gas industries—principally the northwestern and southeastern sections of New Mexico—have received community assistance

grants for needed public facilities projects in accordance with CAC eligibility requirements and rules and regulations. A complete summary of the projects funded in those political subdivisions impacted by the oil and gas industries is attached. However, briefly, these areas have received over $15 million from this program for water, sewer, street, and bridge projects, as well as for planning studies.

As Congressman Skeen stated in his news release announcing these hearings, there are special needs in areas impacted by the expanding development of energy resources in our State and these needs and impacts "can be as diverse as housing, fire and police protection, highways, and manpower." Our CAC program has done a great deal in assisting the impacted communities within our State. However, it is clear that any expansion in, for example, the natural gas industry, will clearly indicate a need to expand our efforts in mitigating the additional socioeconomic impacts which will arise from such development. This, in turn, will mean there will be a need for additional money.

In 1981, the Community Assistance Council staff completed a study, "An Account of Resource Development in New Mexico." This study was intended to act as a guide for the Community Assistance Council in its determination of community needs for the future. Although the priorities given at that time by communities then eligible for CAC funding may have since changed, the listing is a credible indication both of the extensive public needs of communities throughout New Mexico and of the funding needed to assist in the construction of these public projects. For example, the total cost estimates developed for this section—the southeastern section—of the State for projects is over $36 million. The projects range from construction of a fire substation to highway and water and sewer line repairs.

While the State can only "guesstimate" future needs of its communities impacted by energy development, it is obvious that communities in the Abo formation area will be impacted if projected development occurs.

An article published in the Oil and Gas Journal last year stated that the Abo region is "estimated to hold potential resources of 3 trillion cubic feet" of gas. This is just an estimate and cannot be verified until a history of production from wells is established. However, it is certain that the State will continue to play a vital role in meeting the Nation's energy needs through production of natural gas within our boundaries and that with adequate incentives this type of gas will become a greater and important share of our State's total contribution.

I will now turn to the third area, the role of the Federal Government.

THE ROLE OF THE FEDERAL GOVERNMENT

Mr. Chairman, the State of New Mexico has been quite pleased with the actions of the Federal Energy Regulatory Commission, thus far, to provide price incentives for the natural gas production from unconventional sources. It is obvious that in our State these price incentives have led to great interest in and action by the natural gas industry to develop such resources.

Should price controls continue to exist for the various types of gas produced as defined by the Natural Gas Policy Act, then we would welcome the continuance of the incentives provided by the commission. However, I would like to state that we have always felt that in the long run leaving the determination of price to the market place for the energy industries is a much better "incentive" for developing the needed resources which exist in States like ours. We feel the developments in the oil industry since decontrol of oil prices took place provide adequate evidence in support of this statement.

This is not to say that the Federal Government cannot play a role in the furthering of new technologies which the industry believes are needed. This, of course, could be achieved through research and development efforts at the Federal level. For your information, Mr. Chairman, we do have in New Mexico a petroleum recovery research center which is very involved with research and development efforts for enhanced oil recovery.

In addition, we also have our New Mexico Research and Development Institute, which may also get involved in the development of new technologies for recovery of oil and natural gas from unconventional sources.

Therefore, since we in New Mexico will do "our part" for the future development of energy resources, we feel it is important for a committee such as this one to look into ways for the Federal Government to become involved.

In addition, the Federal Government's involvement should not be limited to simply increasing incentives for increased production. As the fourth largest producer of natural gas in the Nation, New Mexico feels the impacts of that production—both the positive and negative impacts. Our community assistance program can only do so much. For this reason, the State has always been in favor of Federal legislation which would create a program of Federal assistance for energy-impacted States and communities.

Mr. Chairman, such legislation has been around for years with no concrete action ever being taken in Congress. The State would be more than willing to provide your committee, at a later date, with the projections we have developed on future energy production in New Mexico. These projections would give you an even clearer picture of New Mexico's role in providing energy resources to the rest of the Nation as well as what the potential negative impacts of that development might be for the State.

In closing, Mr. Chairman, we appreciate the efforts of this committee and would very much appreciate your detailed review of this matter of impacts for energy development.

For Governor King and myself, I thank you again for giving me this opportunity to testify today.

[The prepared statement of Mr. Turpen follows:]

STATEMENT OF CHARLES D. TURPEN, SECRETARY, DEPARTMENT OF ENERGY AND MINERALS, STATE OF NEW MEXICO

Chairman White, members of the subcommittee, it is indeed a pleasure and an honor to be here today to testify before the Energy Development and Applications Subcommittee of the House Committee on Science and Technology.

Before I begin my presentation, let me first welcome you, on behalf of Governor King, to our State. I am certain these hearings will be of benefit to everyone here today and will give you some ideas for policy directions and guidelines.

The State of New Mexico believes the topic for this hearing—"The Natural Gas Option—New Resources and New Technologies"—is of vast importance to the State and the rest of the country. This, of course, is because New Mexico is a major producer as well as consumer of natural gas. The oil and natural gas industry—which in 1980 alone provided 24,300 jobs and direct revenues of $709.8 million to the State—has played a extremely important role in the State's economy. However, these facts also indicate that the State plays a major role in helping to meet the Nation's energy needs through its production of natural gas. In this regard, Mr. Chairman, it should be noted that New Mexico ranks fourth in the Nation in natural gas reserves and fourth in the production of natural gas.

With the number of jobs and revenues generated by the natural gas industry in the State and with almost 90 percent of the State's production being primarily disposed of in interstate commerce, it is quite easy to realize why a discussion of further developments in the industry is of great interest to us as well as yourselves.

Mr. Chairman, it is my understanding that for this hearing you are interested in the following information from the State:

1. The State permitting process for recovery of natural gas from unconventional resources, i.e. tight formation gas;
2. How the State has handled socio-economic impacts from energy development and what the potential future needs in this area might be; and
3. What we perceive the role the Federal Government should be in providing incentives for this additional natural gas production.

Therefore, my testimony will address these three issues in the above-stated order.

THE STATE PERMITTING PROCESS

Briefly, as you know the Natural Gas Policy Act of 1978 (NGPA) provided increased prices as incentives for the production of natural gas which might not otherwise be produced. One of these incentives is given for the production of gas from tight formations—also known as tight sands or tight gas.

The Oil Conservation Division of the New Mexico Energy and Minerals Department, is the agency responsible for making a recommendation to the Federal Energy Regulatory Commission on the propriety of allowing this price incentive for gas produced from various tight formations. This recommendation is based upon the ability of the formation to meet certain criteria contained in regulations issued under section 107 of the NGPA.

The application and evidence are then considered at a public hearing held by either the Oil Conservation Commission (an "independent" commission, comprised of the commissioner of public lands, the State petroleum engineer, and the State geologist) or one of the oil conservation division's hearing examiners. After the public hearing is held, the division makes its recommendation to the Federal Energy Regulatory Commission.

The devision has received twenty-two (22) applications for tight formation designation in both the northwestern and southeastern sections of the State. Of these twenty-two (22) applications, the division has approved eighteen (18), submitting its recommendations for approval to the Federal Energy Regulatory Commission. The Commission has approved eight (8) of our recommendations to date. As far as the State process is concerned, only four (4) cases currently remain to be acted upon by division examiners.

The oil conservation division has not denied any cases so far; however, we have limited the areal extent of some applications based on evidence in the record. The areas we have approved range in size from 33,500 acres to 1,536,000 acres, with a current total of 2,257,318 acres approved.

Our biggest success story under this program is the ABO tight formation area in Chaves and Debaca Counties. We have had over six hundred (600) applications to drill and four hundred (400) completions since our approval of this area in February, 1981. 1981 production in this area was approximately 7,908,865 mcf, with cumulative production, to date, at 9,477,949 mcf.

This "107 gas" production through New Mexico presently accounts for approximately 2.5 percent of our total natural gas production. However, with the right incentives and development of new technologies, it is quite possible that our natural gas production from unconventional sources could account for a much greater share of the State's total production in the very near future.

MITIGATION OF SOCIO-ECONOMIC IMPACTS

I know that Congressman Skeen is particularly interested in the socio-economic impacts of any increased development of this "new" natural gas. In this regard, I would like to outline the process we have been working with in New Mexico for the mitigation of such impacts from energy and mineral development.

In our State, we have what is called the community assistance program under the auspices of the New Mexico Community Assistance Council. The New Mexico Community Assistance Council was created under the New Mexico Community Assistance Act of 1977 to administer a grant program of financial assistance "for solving the community problems arising from rapid growth in areas near the development of mineral and energy resources." Under the community assistance program definition, an eligible grantee must be a political subdivision of the State.

Membership on the council consists of the secretaries of the energy and minerals department, the health and environment department, the department of finance and administration, and the State planning division. In addition, five members are appointed by the Governor. Each appointee represents one of the five community assistance council (CAC) districts.

Since 1977, legislation enacted annually has provided that financing for needed projects would come from the issuance of severance tax bonds. (The only exception to this was in 1978 when monies were appropriated from our general fund.) Over the past five years of the program, a total of $34,475,000 has been appropriated for projects recommended for funding by the council and approved by the State board of finance. For the record, I am attaching a copy of a table which breaks down the funding levels for each year.

In addition, the 1979 New Mexico State Legislature appropriated $500,000 for advanced planning/study grants for CAC approved projects. Another $150,000 was appropriated in 1981 for the same purpose.

Since the inception of the community assistance program those areas in the State which are impacted by developments in the oil and gas industries—principally the northwestern and southeastern sections of New Mexico—have received community assistance grants for needed public facilities projects in accordance with CAC eligibility requirements and rules and regulations. A complete summary of the projects funded in those political subdivisions impacted by the oil and gas industries is attached. However, briefly, these areas have received over $15 million from this program for water, sewer, street and bridge projects as well as for planning studies.

As Congressman Skeen stated in his news release announcing these hearings, there are special needs in areas impacted by the expanding development of energy resources in our State and these needs and impacts "can be as diverse as housing, fire and police protection, highways, and manpower." Our CAC program has done a great deal in assisting the impacted communities within our State. However, it is clear that, any expansion in, for example, the natural gas industry, will clearly indicate a need to expand our efforts in mitigating the additional socio-economic impacts which will arise from such development. This, in turn, will mean there will be a need for additional monies.

In 1981, the community assistance council staff completed a study, "An Account of Resource Development in New Mexico." This study was intended to act as a guide for the community assistance council in its determination of community needs for the future. Although the priorities given at that time by communities then eligible for CAC funding may have since changed, the listing is a credible indication both of the extensive public needs of communities throughout New Mexico and of the funding needed to assist in the construction of these public projects. For example, the total cost estimates developed for this section (the southeastern section) of the State for projects is over $36 million. The projects range from construction of a fire substation to highway and water and sewer line repairs.

While the State can only "guesstimate" future needs of its communities impacted by energy development, it is obvious that communities in the ABO formation area will be impacted if projected development occurs.

An article published in the Oil and Gas Journal last year stated that the ABO region is "estimated to hold potential resources of three trillion cubic feet" of gas. This is just an estimate and cannot be verified until a history of production from wells is established. However, it is certain that the State will continue to play a vital role in meeting the Nation's energy needs through production of natural gas within our boundaries and that with adequate incentives this type of gas will become a greater and important share of our State's total contribution.

THE ROLE OF THE FEDERAL GOVERNMENT

Mr. Chairman, the State of New Mexico has been quite pleased with the actions of the Federal Energy Regulatory Commission, thus far, to provide price incentives for the natural gas production from unconventional sources. It is obvious that in our State these price incentives have led to great interest in and action by the natural gas industry to develop such resources.

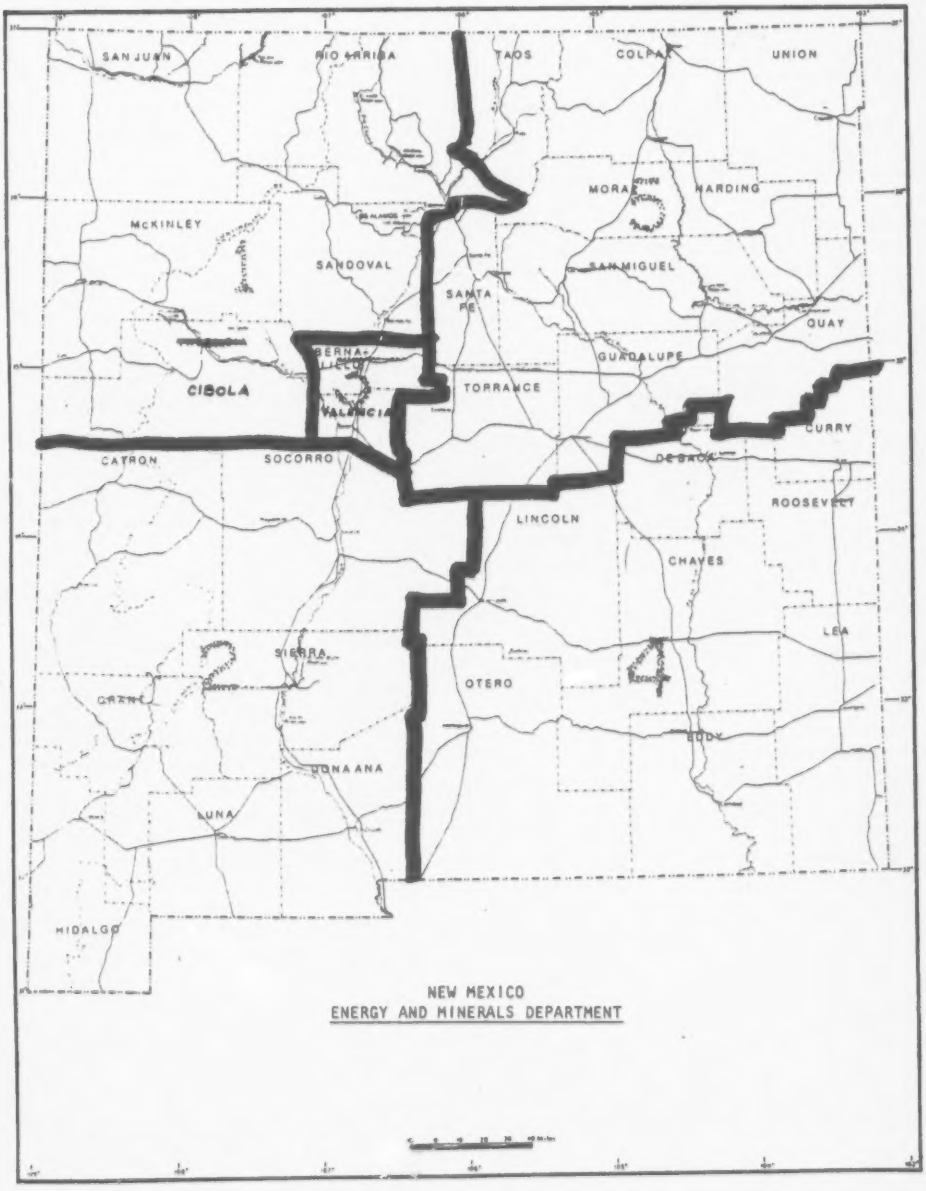
Should price controls continue to exist for the various types of gas produced as defined by the Natural Gas Policy Act, then we would welcome the continuance of the incentives provided by the commission. However, I would like to state that we have always felt that in the long run leaving the determination of price to the marketplace for the energy industries is a much better "incentive" for developing the needed resources which exist in States like ours. We feel the developments in the oil industry since decontrol of oil prices took place provide adequate evidence in support of this statement.

This is not to say that the Federal Government cannot play a role in the furthering of new technologies which the industry believes are needed. This, of course, could be achieved through research and development efforts at the Federal level. For your information, Mr. Chairman, we do have in New Mexico a petroleum recovery research center which is very involved with research and development efforts for enhanced oil recovery. In addition, we also have our New Mexico Research and Development Institute which may also get involved in the development of new technologies for recovery of oil and natural gas from unconventional sources. Therefore, since we in New Mexico will do "our part" for the future development of energy resources, we feel it is important for a committee such as this one to look into ways for the Federal Government to become involved.

In addition, the Federal Government's involvement should not be limited to simply increasing incentives for increased production. As the fourth largest producer of natural gas in the Nation, New Mexico feels the impacts of that production—both the positive and negative impacts. Our community assistance program can only do so much. For this reason, the State has always been in favor of Federal legislation which would create a program a Federal assistance for energy-impacted States and communities.

Mr. Chairman, such legislation has been around for years with no concrete action ever being taken in Congress. The State would be more than willing to provide your committee, at a later date, with the projections we have developed on future energy production in New Mexico. These projections would give you an even clearer picture of New Mexico's role in providing energy resources to the rest of the Nation as well as what the potential negative impacts of that development might be for the State.

ATTACHMENT "A" CAC DISTRICT MAP



ATTACHMENT "B"

NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
COMMUNITY ASSISTANCE PROGRAM

FUNDING TABLE

Year	Construction Project Appropriation	Planning Study Appropriation	Number of Funded Projects	Amount of Reverted Funds
1977	$10,000,000	$ -0-	32	$ -0-
1978	1,500,000	-0-	8	-0-
1979	7,975,000	-	25	-0-
	-	500,000*	6	-0-
1980	5,000,000	-0-	19	-0-
	-	-	5	264,740**
1981	10,000,000	-	32	
	-	150,000	11	
Total	$34,475,000	$385,260 (Excludes reverted funds)	116 Construction 22 Planning	$ 264,740

Total Funds Committed to Date for Projects and Planning Studies are:

$34,860,260.00

ATTACHMENT "C"

NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
COMMUNITY ASSISTANCE PROGRAM

PROJECTS FUNDED IN AREAS IMPACTED BY THE OIL AND GAS INDUSTRY

		1977 Funding Year
Water Projects --	Hobbs	$ 786,000.00
	Carlsbad	439,740.00
	Cuba	225,000.00
	Aztec	550,000.00
	Bloomfield	347,000.00
	Farmington	1,366,785.00
	Farmington	250,000.00
	San Juan: Lower Valley	196,300.00
	San Juan: Flora Vista	111,582.00
	San Juan: Lee Acres	170,300.00
	San Juan: Southside	170,300.00
	San Juan: West Hammond	128,830.00
	San Juan: Blanco	145,300.00
	1977 Total	$ 4,887,137.00

1978 Funding Year

Water Projects -

Aztec	$ 216,000.00
Lovington	200,000.00
1978 Total	$ 416,000.00

1979 Funding Year

Water Projects -

Aztec	$ 450,000.00
San Juan: Lee Acres	195,000.00
Bloomfield	183,500.00
Carlsbad	900,000.00
Sub Total	$1,728,500.00

Sewer Projects -

Bloomfield	$ 70,000.00
Farmington	241,800.00
Sub Total	$ 311,800.00

Bridges Projects -

San Juan County	$ 660,000.00
San Juan County	400,000.00
	$1,060,000.00

Streets Projects -

Bloomfield	$ 600,000.00
Farmington	725,000.00
	$1,325,000.00

1979 Funding Year (continued)

School Projects -		
	Farmington Schools	$ 251,460.00
Planning Studies -		
	Cuba	55,000.00
	1979 Total	$4,731,760.00

1980 Funding Year

Water Projects -		
	Aztec	$ 25,000.00
	Aztec	175,000.00
	San Juan: Lower Valley	235,000.00
	Carlsbad	93,000.00
	Sub Total	$ 528,000.00
Sewer Projects -		
	Carlsbad	$ 202,000.00
Buildings Projects -		
	San Juan County	$ 385,000.00
Streets Projects -		
	Farmington	$ 485,000.00
Planning Studies -		
	Bloomfield	$ 10,000.00
	Aztec	15,500.00
	Sub Total	$ 25,500.00
	1980 Total	$1,625,500.00

1981 Funding Year

Water Projects -		
	San Juan: Upper La Plata	$ 90,000.00
	Cuba	83,000.00
	Eunice	154,000.00
	Lovington	400,000.00
	Aztec	254,600.00
	Loving	160,000.00
	Sub Total	$1,141,600.00
Sewer Projects -		
	Carlsbad	$ 380,000.00
	Hobbs	709,230.00
	Sub Total	$1,089,230.00
Streets Projects -		
	Farmington	$ 500,000.00
	Hobbs	520,000.00
	Sub Total	$1,020,440.00
Buildings Projects -		
	Bloomfield	$ 450,000.00
Planning Studies -		
	San Juan County	$ 12,000.00
	Aztec	9,000.00
		$ 21,000.00
	1981 Total	$3,722,270.00

99-979 O - 82 - 9

BIOGRAPHICAL SKETCH

CHARLES D. TURPEN, Secretary
New Mexico Energy and Minerals Department

PROFESSIONAL EXPERIENCE

- Secretary, New Mexico Energy and Minerals Department
  May, 1982 - present
- Deputy Secretary, New Mexico Energy and Minerals Department
  November, 1979 - April, 1982
- Administrative Assistant to the Secretary
  New Mexico Department of Taxation and Revenue
  April, 1978 - October, 1979
- Director, Tax Research Division
  New Mexico Department of Taxation and Revenue
  June, 1972 - March, 1978
- Research Assistant (Economics)
  University of New Mexico, Albuquerque, New Mexico
  September, 1969 - May, 1972
- Technical Advisor, U.S. Peace Corps
  Talca, Chile
  June, 1966 - June, 1969

EDUCATION

M.A., Economics, University of New Mexico, Albuquerque, New Mexico
1972

B.A., Economics and International Relations
University of Kansas, Lawrence, Kansas
1966

PERSONAL INFORMATION

Age: 38
Married to: Yolanda Maria
Daughters: Genise, Pamela

Mr. SKEEN. Thank you, and would you extend my appreciation to the Governor as well.

Dorothy Hellums.

Ms. HELLUMS. Thank you, Mr. Chairman. I am Dorothy Hellums. I am a commissioner in Chaves County, and I appreciate the opportunity to testify before this subcommittee.

We are in fact experiencing significant socioeconomic impacts of a large scale, due to the rapid expansion of oil and gas activities and related services in Chaves County. The most critical problem we are facing is the inability to address these associated impacts initially due to our limited financial and manpower resources. More specifically, we are experiencing serious problems which include the rapid deterioration of our county roads due to the greatly increased volume of heavy equipment, trucks and other associated traffic created by this activity, and the immediate necessity to provide additional solid waste facilities and increased fire and law enforcement protection.

We want to emphasize that these problems and the inability to resolve them are experienced by not just Chaves County but by any county or community that has such a rapid almost overnight expansion of such activities when a large area is suddenly opened to energy development. Even though there are revenues that will eventually be generated through the taxes associated with this type of energy activity to resolve some of these impacts, significant revenues are not available for the first 2 to 3 years when the impacts are the greatest. These impacts cannot be addressed without some form of immediate financial assistance during this initial period.

In regard to the question of regional planning for the socioeconomic impacts, the initial impacts we have mentioned are almost impossible to plan for since the rapid, booming expansion of these activities happen suddenly and almost without advance notice. Regional planning is a process that takes a great deal of time to evaluate and to implement, and if the initial impacts can be mitigated, the planning process over time we feel can be effectively managed.

The most severe impact on the county is the roads.

Chaves County has approximately 1,750 miles of road to maintain, most of which are dirt roads, compared to adjacent Eddy County with 1,598.57 miles of road and Lea County with 1,411.60 miles. Even with more miles of road to maintain, Chaves County's road department budget last year of $1½ million was less than one-half the size of the adjacent counties' road budgets, and we had to receive a special exception from the State Department of Finance to decrease our ending cash balance below acceptable limits in order to budget an additional $500,000 this year specifically for energy-impacted roads. Not only do we have more miles of road to maintain normally at a smaller budget than adjacent counties, the impacts from our increases in oil and gas traffic are substantially greater to our roads. The tremendous increase in the volume of traffic alone in the last year, coupled with the significant fact that the increases in volume are primarily from large heavy trucks and equipment, has rapidly deteriorated approximately 275 miles of severely impacted roads to an extent that reconstruction and improvements are urgently needed immediately at estimated costs

beyond $10 million. This does not include the other less severely impacted roads throughout the county.

Other major impacts affecting the county that need urgent attention are fire and law enforcement protection and waste disposal.

Fires during the last year have increased by 75 percent over the previous year. We expect that there will be at least an additional 50-percent increase each year in the next 2 to 3 years. The projected increase in costs for providing this additional fire protection we estimate at approximately $1.8 million in expanded facilities and equipment.

Similarly, the increased energy activity and growth has created the need for increased law enforcement. We recently started construction of a new juvenile detention facility which was required by State mandate due to increased juvenile crimes, and due to projected growth rate and increased crime rate, we expect an estimated $6.15 million will be necessary to equip and staff law enforcement facilities in the near future, and within 5 to 10 years a new adult jail facility will most likely be necessary at a cost of approximately $7 million.

Chaves County has four landfill sites. Due to the increased energy activity in the last year, our current waste disposal facilities are already inadequate. The county can no longer service the three landfills south of Roswell to any extent due to the tremendous increased usage of the landfill site north of Roswell. This can definitely be attributed to the increased commercial and industrial activities and population increases associated with energy growth and development.

This has resulted in improper storage and open dumping of refuse. Potential exposure to toxic fumes from hazardous chemical waste material poses a threat to humans and livestock. Inadequate waste disposal facilities has and will continue to create significant air and water pollution problems and resultant health hazards.

These problems have created the immediate need for at least one more landfill site north of Roswell. Since EID has closed one of our landfills south of Roswell effective September 1982, we must procure a new landfill site in the south. We currently estimate that $31,000 is necessary for additional landfill sites. Equipment immediately needed is estimated at a cost of $243,000. Future needs in the next 2 to 3 years for equipment and manpower is estimated at an additional cost of $318,000, for a total cost of approximately $592,000.

We have briefly stated only the most urgent and immediate problems and costs associated with the impacts of energy activity, although there are many other impacts we will not address in this statement, and will now briefly touch on the revenues we receive to resolve these impacts.

It is important to note that there have been numerous statements by members of the legislature, oil and gas representatives and others that due to the increased oil and gas activities Chaves County will generate large tax revenues to resolve these impacts. We want to strongly emphasize that during the initial impact for the first 2 to 3 years of development this is, and will not be, the case, although we do anticipate that after that initial period there should be revenues available to resolve most of these problems.

Last year we budgeted $800,000 for revenues from gas and oil and were provided projections that these revenues would probably exceed $1 million. We actually received $662,000. There were originally projections that the county would receive upwards of $1.3 million in gas and oil revenues this fiscal year, and the county budgeted $1.1 million last May based on these projections. Our most current recent projections show that only approximately $950,000 will be generated this fiscal year. The statements and projections regarding large revenues apparently have not taken into account that once the well has been drilled, there must be gas lines constructed to transport the gas, the gas must be sold and reported to the Federal Government for taxing purposes, part of the tax revenues sent to the State and recorded, and then part of those revenues sent back to the county, all of which is a very time-consuming process. These projections have also not included contingencies such as the discontinuance of constructing gas lines due to economic conditions and contractual negotiations which in fact has happened here in Chaves County, and presently new gas lines are not being constructed. This has caused considerable delays in the time that the Federal Government and the State and the county receives the revenues which in large part accounts for our receiving approximately one-half of the projected revenues that had been projected by members of the State legislature and representatives of oil and gas industry. And even if the revenues were as great as the most optimistic projections have been, they would still be only a small part of the funds necessary to resolve the problems, since the cost we have estimated to resolve only part of these problems exceeds $12 million.

In the meantime, the impacts continue, legitimate complaints from Chaves County citizens increase, and the county has no recourse for generating the funds necessary to address these problems.

We are recommending that this committee investigate the alternatives of providing some type of initial impact financial assistance to communities such as ours that have no means to address the severe impacts of sudden expansion of energy activities.

We have provided this committee a document entitled Chaves County impact report "Energy Development," which includes a more detailed overview of the extent of energy activity in Chaves County and associated impacts, and we also have additional data, statistics, and other information in order to help answer any specific questions you may have.

Thank you, Mr. Chairman.

[The prepared statement of Dorothy Hellums follows:]

CHAVES COUNTY COMMISSIONERS
P.O. BOX 1817
ROSWELL, NEW MEXICO 88201

COMMISSIONERS:
Terry Lee Aiello
Chairman
Dorothy Hellums
C.W. (Cliff) Wagner

COUNTY MANAGER:
Curtis Woolf
(505) 623-4341

July 20, 1982

Subcommittee on Energy Development
and Applications House Committee on
Science and Technology
Room B-374
Rayburn House Office Building
Washington, D. C. 20515

Atten: Mary Bly

Ms. Bly:

Thank you for the opportunity to speak for the citizens and multiplicity of business factions located in Chaves County, New Mexico. Our economic base has always been strong and varied, however, we were unprepared to handle the socioeconomic impact due to the large scale development of natural gas in Chaves County.

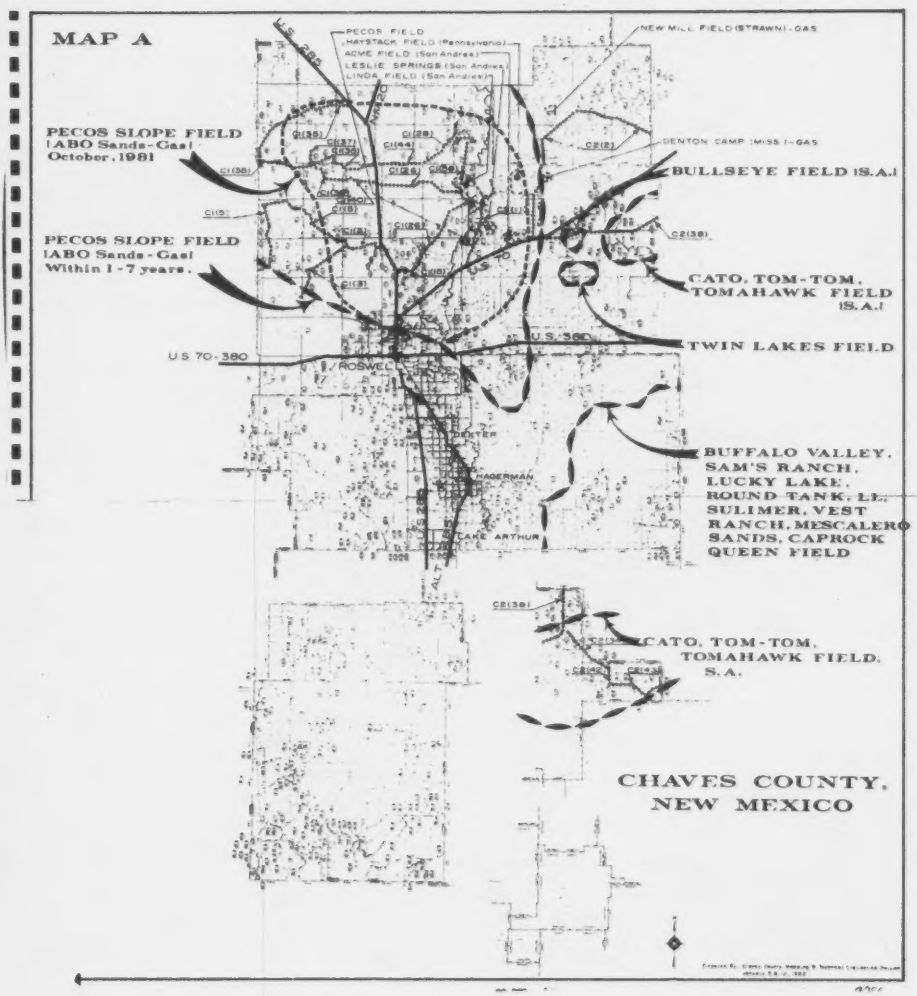
Being a native of the Great State of New Mexico with a varied background in the banking field, I have seen many changes in the ageless face of Southeastern New Mexico. As County Commissioner of District #2 I cover many facits of our County. Working close by with my constituents in our Parent Teachers Organization as member, and past President. Member of the: Berrendo Cowbells; Noon Optimist Little League; Roswell AABC, (finance person); Chairperson of various community committee's; and 1st Methodist Church. I am also Secretary Treasure of HELCO; Vice President of HGE Corp. as well as wife, mother and domestic engineer.

Again we are pleased that you would take time to hear and hopefully assist Chaves County during our impacted growth period.

Sincerely,

Dorothy Hellums
Chaves County Commissioner, District #2

DH/klm


MAP A
PECOS SLOPE FIELD (ABO Sands-Gas) October, 1981
PECOS SLOPE FIELD (ABO Sands-Gas) Within 1-7 years.
PECOS FIELD (HAYSTACK FIELD (Pennsylvania) ACME FIELD (San Andres) LESLIE SPRINGS (San Andres) LINDA FIELD (San Andres))
NEW MILL FIELD (STRAWN)-GAS
DENTON CAMP (MISS.)-GAS
BULLSEYE FIELD (S.A.)
CATO, TOM-TOM, TOMAHAWK FIELD (S.A.)
TWIN LAKES FIELD
BUFFALO VALLEY, SAM'S RANCH, LUCKY LAKE, ROUND TANK, LL, SULIMER, VEST RANCH, MESCALERO SANDS, CAPROCK QUEEN FIELD
CATO, TOM-TOM, TOMAHAWK FIELD, S.A.
CHAVES COUNTY, NEW MEXICO
U.S. 285
U.S. 70-380
U.S. 380
ROSWELL
HAGERMAN
DEXTER
LAKE ARTHUR

CHAVES COUNTY IMPACT REPORT

"ENERGY DEVELOPMENT"

PRESENTED TO:

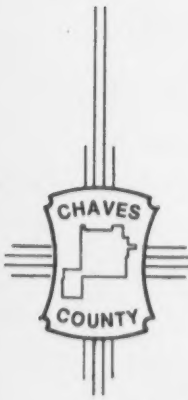
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
FIELD HEARING, ROSWELL, NEW MEXICO

prepared by:

CHAVES COUNTY

JULY 20, 1982



CHAVES COUNTY COMMISSIONERS
P.O. BOX 1817
ROSWELL, NEW MEXICO 88201

COMMISSIONERS:
Terry Lee Aiello
Chairman
Dorothy Hellums
C.W. (Cliff) Wagner

COUNTY MANAGER:
Curtis Woolf
(505) 623-4341

May 4, 1982

Congressman Joe Skeen
Room 127 - Federal Building
Roswell, New Mexico 88201

STATEMENT OF IMPACT, CHAVES COUNTY, NEW MEXICO

Escalating growth, due to exploration, drilling and production of gas, is creating a major economic impact on Chaves County, New Mexico, since the recent discovery of the Abo/Pecos Slope Play, less than two years ago. In the Abo Slope area, located in the North, Northeast sections of Chaves County, gas production increased five and one-half times during the past twelve months, from 300 million cubic feet of gas per month in February of 1981, to over 1½ billion cubic feet of gas in February 1982. As of February 1982 there were 182 active wells, 350 million cubic feet of gas is being pumped per day from each well, with production in most wells expected to continue for at least 10 years. Shallow

drilling in the Abo Pecos Slope, the average depth of the current 25 rigs drilled is only 4,400 feet, allows for more well locations per section (640 acres per section) as compared to deep drilling in other gas fields which allows only 1 to 2 wells per section. Three fourths of the Abo Pecos Slope, or 570,000 acreas (44% Federal Land) will probably be productive with approximately 3,000 wells. The success ratio currently for drilling is 86%.

Using utilities connections in the past year as a source to estimate current population, Chaves County has experienced over a 35% increase in population since 1980. This figure nearly doubles the total growth, 17% increase, Chaves County experienced from 1970 to 1980. The demand for services, housing, office space, utilities has seen a sharp increase. Building permits are up over 98% in the County in the first four months of 1982 over the total permits issued for 1981. Traffic on county roads are up 20% over last year, heavy truck traffic is up 136% over 1981. All economic indicators show that Chaves County is experiencing a major growth impact. Some 400 oil, gas and related industries are now located in Chaves County and demand for industrial land for facility location is up drastically. 350,000 square feet of new office space, amounting to over a $20 million investment, has been announced since January 1982 to handle the influx of companies and services due to the rapid expansion and growth of business opportunities in the County.

Staggering financial problems aren't imminent, but facing Chaves County today. Over $30 million is needed currently for water main expansions, fire coverage, law enforcement, solid waste disposal, county roads, truck by pass and county planning and zoning. The drilling, completing and pipe lining required to develop this area requires a tremendous amount of truck transportation. County roads in the area have been severely damaged since the county currently has little money with which to maintain or improve the roads. Over 700 vehicles, most of which are heavy trucks, are required to support the 25 rigs presently drilling. Chaves County needs approximately $10.9 million to bring these roads up to standard condition at this time. Most truck traffic originates from Roswell, Artesia and Hobbs, New Mexico, and results in the city, county and state roads on the North and East sides of Roswell being severely impacted. Chaves County needs an adequate truck by pass system to remove the congestion and to eliminate the safety problems which have developed. Projections of traffic and accident frequency show that accidents are likely to increase by 64% in 1982 in the City of Roswell, located ten miles South of the Abo Play, due to the density of heavy truck traffic increase on their Main Street. The cost estimates for a two lane truck by pass is $10 million. Due to the economic impact of the Abo Pecos Slope, County Services, land and equipment for solid waste

disposal requirements must be met, water line expansions and water rights must be obtained, substations and equipment to provide fire coverage is needed, facilities, personnel and equipment to provide adequate law enforcement must be obtained because of the increase of crime accompanying the rapid growth. The current liquid waste disposal for the area is presently not meeting the demand for the community and is operating at 20% over capacity.

Utility companies are projecting major increases in demand of their services. Mountain Bell Telephone Company programed Work in Chaves County 1982-1984, shows a percentage of increase of 91% in the North Sector, 35% in the East, 20% in the South and 47% in the West. The Gas Company of New Mexico is planning on projected connections for total population in two to five years of 110,000 for this area. The Gas Company of New Mexico had a total of 15,932 connections as of the end of 1981.

Chaves County New Mexico is now faced with petitioning any available source for funds to offset the astounding growth that has besieged the area.

ROSWELL NORTH SOUTH TRUCK BY PASS

Directly and indirectly, every citizen of Chaves County and the great state of New Mexico has a stake in the roads and streets that permit motor vehicle travel. We are both contributors and beneficiaries. Within the past year, nearby oil and gas production has brought much activity in the Roswell and Chaves County area and as a result of this development, it has caused a tremendous increase in heavy vehicular traffic on the main arterial streets of Roswell.

The importance of the truck by pass will effect every phase of our economy. Time savings alone will be enormous. Congestion within the central core area will be largely bypassed, and it will be possible to travel from one end of our main arterial highway to the other at good sustained travel speeds, unimpeded by traffic lights, or intersections.

Industry figures show about 94% of the states oil and gas production comes from the counties of Lea, Eddy, Chaves, and Roosevelt. New Mexico Oil Corporation states that a multi-pay area of some one million to 1.5 million acres for potential development in the Chaves County area and that exploration and development activity will be going on at an increased pace for some 10 to 15 years.

Roswell is becoming the focal point. It is considered the "New Era" in the production of oil and gas. The present and anticipated future development of these fields which would be serviced by the truck by-pass is of tremendous importance to New Mexico and Chaves County for revenue, tax, business and employment reasons.

The Pecos Slope and ABO Field development and surrounding area located within Chaves County has shown phenomenal activity and rapid growth over a relatively short period.

It is the public interest, for federal, state and local, that a truck by pass be expeditiously provided to accomodate and sustain further and continued development activity. Nothing contributes more to the economic strength of an area than the roads that it serves.

Because of Roswell and Chaves County's strategic position in Southeastern New Mexico, it has become the center of retail, wholesale, agricultural and industrial activities for the entire area. It is the largest trading center between Albuquerque, Amarillo, Lubbock and El Paso.

The advent of near oil production has brought much development in the Roswell and Chaves County area. The United States Geological Survey Regional Office is located in Roswell and administers government interests in oil over all of New Mexico and ajoining states.

The development of the North South Truck By Pass will continue to aid community leaders in the Roswell area, who working with various government agencies have come up with a unique plan. It is aimed in keeping New Mexico in a growth cycle and providing a multiplicity of opportunities for the states growing population.

Thus Chaves County New Mexico is now faced with petitioning any available source for funds to offset the astounding growth that has besieged our area.

The elected officials of Chaves County strongly support the development and construction of the North-South Truck By Pass around Roswell (see attached Resolution #R-70-32).

RESOLUTION NO. R-70-32

WHEREAS, there exists in Chaves County, a need for a truck By-Pass north and east of Roswell, Chaves County, New Mexico; and

WHEREAS, the route would be east on Pine Lodge Road (County C1(105); to a crossing on the AT & SF Railway; thence continuing east to Red Bridge Road (County C1(106); thence, south along said Red Bridge Road (County C1(106) to Nineteenth Street, State Road 253); thence continuing south along State Road 253 to East Second Street (U.S. 380); thence east along US 380 to State Road 253 South; thence, south along State Roads 253, 254, County C1(245); along a curve south-westerly, crossing the AT & SF Railway; along a curve to the south and along County Road C1(187) to an intersection with U.S. Highway 285.

NOW, BE IT RESOLVED, that the Truck By-pass Route described above, be, and is hereby adopted as the official route for the proposed Truck By-pass north and east of Roswell.

IN WITNESS WHEREOF, this Resolution has been adopted, effective February 11, 1982.

BOARD OF CHAVES COUNTY COMMISSIONERS

Terry Lee Aiello, Chairman

C. W. (Cliff) Wagner, Member

Dorothy Hellums, Member

ATTEST:

County Clerk

CHAVES COUNTY ROAD SYSTEM
ENERGY IMPACT ASSESSMENT OF NEED

OVERVIEW:

A. Presently we have an approximate total of 1,750 miles of maintained roads within Chaves County.

B. Of these we have determined that an estimate of 582.7 miles of these roads should be considered as "Energy Impacted".

C. We have further determined that approximately 273.4 miles of the "Energy Impacted" roads are in most urgent need of reconstruction. (These are outlined county roads as indicated by Map "A"). (See Appendix A., List of Urgent "Energy Impact" Roads).

1. Approximate cost improvements (current 1982 costs by independent contractor in February 1982) equals $11,098,900.

2. Approximate cost beginning construction July, 1982 (plus 10%) $12,208,790.

SCOPE OF ASSESSMENT:

A. County roads in and to producing gas and oil fields in Chaves County.

B. Anticipated impact on remainder of county road system.

C. Impact in city streets and federal and state highways in Chaves County.

99-979 O - 82 - 10

PRELIMINARY COST SUMMARY:

A. See "LIST OF URGENT ENERGY IMPACT ROADS," which are listed in order of priority. This is used in coordination with Map "A". Which is a breakdown of the $11,098,900. road improvement estimate.

B. U.S. 285, 70 and 380, along with State Roads in Chaves County are being impacted with increasing severity.

C. The remainder of the county road system, being some twelve hundred miles, more or less, is without question being impacted.

D. All municipalities in Chaves County are being impacted as well, especially in the area of roads and streets.

ESTIMATING PROCEDURES:

A. The factors on which these figures are based are:

1. Length of roads.

2. Estimated haul from material pits. -See Appendix B., "Haul Chart."

3. Cost per mile based on average of various bids received by oil companies from private contractors.

4. All estimates are based on work being done by private contractors, at this time.

5. All cost estimates should be adjusted upward at time of actual construction.

CONCLUSION:

Every effort has been made by the elected officials of Chaves County, after input from our retail, wholesale, agricultural, and industrial activities for the entire area to mitigate this impact. Our highly diversified economy consisting of irrigated farms, livestock, feeding, retail, and wholesale distribution, oil development, tourism, education, and industries is being severely impacted by the lack of present funding to maintain our system of 1,750 miles of Chaves County roads. Our most urgent need still rests with the 273.4 miles of "Energy Impacted Roads", within the outlying areas of Chaves County. Chaves County New Mexico is now faced with petitioning any available source for funds to offset the astounding growth that has besieged the area.

REGIONAL PLANNING

The problem of adequate planning for Chaves County isn't imminent but facing us today. The rapid development and impending high production of oil and gas has had a severe impact on the ability of Chaves County to respond to the needs of a greatly expanded population. A population struggling under the constraints of high interest cost associated with day to day living.

Through a process of public hearings commencing in July 1971 to the present Chaves County and its citizens have attempted to develop and implement sound planning and zoning procedures. However, the rapid expansion of population has created many problems.

WATER:

Water is one of our most precious commodities. The protection and conservation of it remains critical in regards to the regional planning. Currently through the Berrendo Cooperative Water Users Association, Inc. (Operating under Chaves County Resolution No. 30 [also known as Chaves County Resolution #68-27]) County residents receive quality water. It should be noted that due to our expansion of population there is an immediate need for an additional $2 million in construction of transmission water lines and new water right acquisition. (Presently Berrendo Water COOP is using 75% of the total owned water rights).

Within 5 miles of the City of Roswell 85% of the population is served with Berrendo water. Prior to January 1982 the COOP was setting 7 to 8 water meters per month, since that time a constant average of 25 installed water meters per month has been maintained.

FIRE PROTECTION:

The coverage is adequate presently, however, with the continued growth of population have come an increase of 50% in fire calls over past years. To that have been oil and gas related auto accidents, chemical spills and hazardous material incidents. To adequately cover this expansion will require 1.8 million dollars in expanded facilities and new equipment.

LIQUID WASTE DISPOSAL:

Complementary with the increasing water supply need within Chaves County is the rapid expansion of individual liquid waste systems. Since only the City of Roswell and municipalities are served by a community sewage system the balance of population influx must rely on septic systems for sewage disposal. Although the State of New Mexico (Environmental Improvement Division) has statutory authority within this area, control and regulation have lagged far behind the current expansion of liquid waste systems. Improperly installed systems constitute a serious ground water contamination potential. Therefore, it is extremely vital that the connection between the waste water discharged from a septic

tank and the ground water being polluted by discharges from improperly installed or operated septic tank systems be addressed.

SOLID WASTE DISPOSAL:

The greatly increased oil and gas activity and resultant population influx additionally increases demands on the solid waste storage, collection, transportation and ultimate disposal systems in Chaves County. Resultant improper storage and open dumping of refuse will expose many Chaves County residents to injury and death through cuts, puncture and disease causing organisms. Additionally, fly populations reach nuisance levels and mechanically transmit a varity of disease organism. Exposure to toxic fumes from hazardous chemical waste containers also constitute potential threats to humans and livestock. Increased population emigration into the county will ultimately and negatively affect current solid waste disposal operations in the county. The expected improper disposal of solid waste will contribute significantly to both air and water pollution of Chaves County and can ultimately adversely affect tourism in the County by the unsightlyness of roadside litter and burning dumps. Finally, the immediate need for equipment at $243,000 and planning for increased impact requiring equipment costing $276,000 is imminent. Planning for added land aquisition is in the process, with an estimated value of $31,000. These are funds that Chaves

County does not presently have, but needs to identify for the health and welfare of County residents (a direct impact from the oil and gas exploration and production.)

LAW ENFORCEMENT:

Presently we have broken ground to build a new juvenile detention facility which is crucially required. With the rapid expansion of population due to the oil and gas exploration and production, our crime rate has escalated and will continue to do so. At the present we only temporarily hold adults for transfer from our County Jail facility. This cannot continue under our rapid growth. A new adult facility coupled with added personnel and equipment would cost the County approximately $7 million, as well as an added $6.15 million to equip and staff law enforcement personnel to patrol the production and exploration fields in the Pecos Slope Field (ABO Sands-Gas); funds which are unavailable at this time.

COUNTY ZONING AND CODES ENFORCEMENT:

County building permits for other than agri-business has increased significantly during the past year, rising from $177,000 to $4.7 million valuation. Presently we are permitting approximately 40% of the new construction growth. County zoning cases have risen from six in 1981 to forty four cases to date in 1982, an 86% increase.

BUDGET IMPACT:

During the 1981-1982 budget year expected revenues from the Oil and Gas Ad Valorem receipts into the County were budgeted at $800,000. Decreases in production due to lack of pipeline transmission decreased that revenue to $662,249.09 (-8.2%) Coupled with severely impacted roads which required a transfer of $500,000 from the general fund to a special fund to guarantee the lease purchase of $567,308 worth of road maintenance equipment, reduced the County balance of cash to below the 5/12th balance required by the State of New Mexico. With a projected budget of $1,000,370.24 from Oil and Gas Ad Valorem Receipts into the general fund for 1982-1983 budget year and the continued decline in revenues over budget, concern over how the County can continue to adequately provide services, maintenance and protection for present as well as the ever increasing new population continues.

Chaves County New Mexico is now faced with petitioning any available source for funds to offset the astounding growth that has besiged the area.

APPENDIX A

LIST OF URGENT "ENERGY IMPACT" ROADS

The following roads are listed in order of priority with an estimated cost of construction.*

	Length (mi.)	Haul Miles	Estimated Cost
C1(44)Parts 1-10	18.9	10	$ 828,750
C1(15)Parts 1 & 2	2.6	7	165,900
C1(26)Parts 1-8	30.8	9	1,201,400
C1(58)Parts 1, 2A, 2B, and 3	9.2	5	313,000
C1(28)Part 1	3.7	7	200,550
C1(35)Parts 1-9	40.2	17	2,274,300
C1(40)Part 1; C1(39)Part 2; and C1(37)Part 4	11.0	4	328,000
C2(1)	19.5	9	800,200
C2(43)	9.1	6	340,450
C2(34)	9.0	7	367,500
C1(37)Part 2	4.0	5	170,000
C1(5)	27.6	16	1,558,200
C2(42)	7.4	3	209,900
C1(3)	19.4	4	542,700
C2(2)	35.0	5	1,022,500
C2(38)	26.0	5	775,000
	273.4	119	$11,098,900

*Use in conjunction with map "A"

APPENDIX B

HAUL CHART

1 mile haul	=	$19,500 per road mile
2 mile haul	=	21,500 per road mile
3 mile haul	=	23,500 per road mile
4 mile haul	=	25,500 per road mile
5 mile haul	=	27,500 per road mile
6 mile haul	=	29,500 per road mile
7 mile haul	=	31,500 per road mile
8 mile haul	=	33,500 per road mile
9 mile haul	=	35,500 per road mile
10 mile haul	=	37,500 per road mile
11 mile haul	=	39,500 per road mile
12 mile haul	=	41,500 per road mile
13 mile haul	=	43,500 per road mile
14 mile haul	=	45,500 per road mile
15 mile haul	=	47,500 per road mile
16 mile haul	=	49,500 per road mile
17 mile haul	=	51,500 per road mile
18 mile haul	=	53,500 per road mile
19 mile haul	=	55,500 per road mile
20 mile haul	=	57,500 per road mile

Technical Note:

The above "HAUL CHART" was used to estimate the cost of construction of roads in Chaves County with eight inches of compacted caliche on a roadbed 24 feet wide. This minimum width is recommended as a safety factor where school buses and other vechicles may pass eighteen wheel trucks.

This basic formula was arrived at by a combined effort, based on field experience, of: The Chaves County Mapping and Engineering Division; the Chaves County Road Department; private road contractors; and oil exploration firms.

APPENDIX C

OIL & GAS AD VALOREM RECEIPTS
INTO GENERAL FUND
FY 1981-1982

ACTUAL RECEIPTS

MONTH	REVENUES	% MONTH-TO-MONTH INCREASE (DECREASE)
JULY	26,038.33	----
AUGUST	26,002.18	(1%)
SEPTEMBER	27,857.05	7%
OCTOBER	27,223.82	(2%)
NOVEMBER	28,781.97	6%
DECEMBER	56,199.44	95%
JANUARY	61,154.81	9%
FEBRUARY	69,392.35	13%
MARCH	98,988.34	43%
APRIL	78,904.53	(20%)
MAY	72,319.98	(8%)
JUNE	89,386.29	24%
TOTAL	662,249.09	

Mr. SKEEN. Thank you very much, Ms. Hellums.

Bill.

Mr. ARMSTRONG. Thank you.

Good afternoon, ladies and gentlemen of the panel, I am Bill Armstrong, Jr., chairman of the board of the Roswell Chamber of Commerce. I will be speaking on the social and economic problems of oil and gas development for the city of Roswell, and the chamber.

On behalf of our Honorable Mayor Peter York and the city of Roswell and the chamber, may I welcome you to New Mexico. We hope you have enjoyed Roswell's hospitality. A special welcome home to our own Congressman, Joe Skeen. Joe ran several times for State-level elective offices, winning some races but losing a close race for the Governorship to our present Governor, Bruce King.

I recall the chamber meeting 4 years ago right in this room in which the invited guests were candidates Joe Skeen and Bruce King. At the end of the debate the chamber leader presented both with a small wrapped gift, in one package the symbol of the Democratic Party, in the other the symbol of the Republican Party. When the candidates unwrapped the packages, both discovered that in the confusion and excitement, the packages had been inadvertently switched. The assembled crowd was doubled over in

laughter, while the chamber officials were red with embarrassment.

Congressman Skeen, we appreciate your humanitarian efforts in educating the people of southern New Mexico to write, to spell, especially the word "Skeen."

Roswell is blessed with a great many assets including outstanding weather, good and hard-working people, responsible elected officials, fine schools and churches, and recently the discovery of a major gasfield that will ultimately contribute much to the economy and the quality of life for all our citizens.

We had through the years the good fortune to have city fathers with enough foresight to plan for sustained progressive growth with as little discomfort to the affected people as possible.

We will continue to try to draw on the wisdom and experience of other Southwest communities who have known similar bust-to-boom economies from oil and gas activities.

On the negative side of the coin, several natural and manmade problems limit us to the orderly growth we might otherwise wish to have. Roswell, Chaves County, and all of New Mexico's growth has been severely inhibited throughout the decades due to a lack of an adequate supply of water. That will continue to be a major problem both for the next 10 years and also the next 100 years. In my opinion Congress needs to address this issue in a rapid and wise manner. Just as we saw in the past what an oil shortfall can do to an oil-dependent economy, be prepared to address the question what a water shortfall will do to a water-dependent economy. Technology has increased our need for water, not reduced it. Water is vital to every phase of this valley's economy: oil and gas, agriculture, including dairy farming and livestock feeding, manufacturing, ranching, and municipal services.

Others here have addressed our immediate needs which are directly related to the impact of oil and gas.

Roswell's transportation modes and facilities are totally inadequate. Roswell desperately needs a total highway truck bypass and loop system.

U.S. 70, the link from Las Cruces to Amarillo must continue to be improved. Our truck and rail freight system is marginal, and our lack of jet air service is unsatisfactory to support a gas-booming economy. The Roswell area terrain has many low and flat areas, often subject to local flooding. Only time and money prevent the city from having an adequate storm drain system so necessary for a growing community.

Over $30 million is needed to upgrade and improve the city's sewage system which will be required for sustained growth.

Under the present system only a small portion of the taxes and royalty generated from oil and gas activity are received into the city coffers. The city needs funding help beyond what they now receive from those areas placing the demands on city systems. I have long contended that Roswell is without peer in New Mexico in the management of its fiscal funds, but there is only so much the city can do until they receive direct oil and gas tax support.

Thank you for your time. Thanks for holding your hearing here. It demonstrates that you are interested in our problems, which are large but not insurmountable.

We stand willing to assist and participate with you. We are proud of Roswell and its leaders. We have so many of the natural assets and all of the talent to see that Roswell's growth establishes a better quality of life for its people. Your concern here will help improve that quality.

As you have heard before, there is no limit to what can be done if you do not care who gets the credit.

Thank you very much.

[The prepared statement of Bill Armstrong, Jr., follows:]

CITY OF ROSWELL

Background Characteristics

The Roswell community, located in Southeastern New Mexico in Chaves County in the Pecos River Valley, began as a meeting point for several cattle operations in the valley. The region's abundant supply of artesian water attracted additional agricultural interests, and agricultural activities soon became the economic base for Roswell and remained that way until the early 1940's. When the United States became involved in the Second World War, Roswell was chosen as a training field for bomber crews. The population of Roswell grew as a result and the economic character of the City changed.

In the later 1950's, additional military installations (Atlas Missile Sites) were moved into the area, and because of Roswell's increasing role as a support community to military operations, light industry and new commercial establishments began to appear. Most of these were directly dependent upon sales to Walker Air Force Base.

By the end of 1967 both the Atlas Missile Program and Walker Air Force Base were terminated and from 1965 - 1968 Roswell lost nearly 10,000 of its population. The negative impact on the community caused by the federal installation closure and subsequent population loss threw Roswell into a severe economic decline. Roswell has to some degree reverted to its basic regional role.

Military activities beginning during the Second World War doubled Roswell's population by 1950 when it reached 25,738 and boosted it further to 39,593 by mid-1960. At that time Roswell's population constituted 68.7% of the Chaves County population.

TABLE 1

COMPARATIVE POPULATION DATA, CITY OF ROSWELL,
CHAVES COUNTY, 1940 - 1980

Year	Roswell	Chaves	City in % of County
1940	13,482	23,980	56.2
1950	25,738	40,605	63.4
1960	39,593	58,600	68.7
1970	33,908	43,400	78.3
1980	37,949	51,103	74.2

SOURCE: U.S. Bureau of the Census

Exactly what occurred between 1960 and 1970 is known only in substance but it is believed that Roswell's population reached a peak of over 43,000 in 1962 before military activities at Walker Air Force Base started to taper off. Moreover, the decline in population in subsequent years is obscured by annexations in the late sixties rendering the 1970 census figure of 33,908 useless as a true indicator of the severe depression in the immediately preceeding years. The 1970 Census also reports, however, that the population in the 1960 incorporated area was only 29,995 in 1970.

TABLE 2

ROSWELL POPULATION CHANGES, 1960-1970
Data from the 1970 U.S. Census of Population

Total Population in 1970	33,908
In 1960 Corporate Area	29,995
In Annexed Area	3,913
1960 Population	39,593
Change in 1960-1970 in 1960 Area	- 9,598

Several factors will tend to either inhibit or encourage growth in various portions of Roswell. Adverse topography, flooding, lack of available land, land use conflicts and deteriorated neighborhood conditions will act as constraints to development in certain areas.

Considerable development can be expected in the northern sector due to the substantial increase in oil and gas activity the community is now experiencing.

The low projection of anticipated future population in Roswell as indicated in Table 3 assumes that most of the existing expansion constraints such as a lack of adequate sewerage facilities, low and medium cost housing, dilapidated residential areas, flooding, deteriorating streets and an outmoded thoroughfare system will continue to exert negative influences on the community's economic and population growth.

TABLE 3

PAST AND ANTICIPATED FUTURE POPULATION
IN ROSWELL, NEW MEXICO, 1900-1995

Year	U.S. Census and Estimates	Projected Population		
		Low	Medium	High
1940	13,482			
1950	25,783			
1960	39,593			
1968	31,857 est. (1)			
1970	33,908			
1980	37,949			
1985		53,135	57,180	61,438
1990		60,494	67,888	76,089
1995		69,274	81,291	95,200

Estimate (1) U.N.M. Bureau of Business Reasearch, 1975
Projection: City of Roswell Water System Master Plan

General Statement

The City of Roswell has developed Master Plans for water, sewer, transportation, and drainage, and is in the process of completing a new comprehensive master plan for overall city development including the five (5) mile area surrounding the city limits.

The rather sudden appearance in 1981 of large scale oil and gas exploration and development has had severe impact on the City of Roswell to implement new and upgraded facilities required to service the industry and provide housing and recreation to employees of this new industry.

Transportation Statement

The transportation network within and around Roswell is totally inadequate to accomodate the increase in heavy oil and gas related trucks. Planning by the City, County, and State have identified the need for Relief Routes around Roswell on U.S. 70 and U.S. 285 and Corridor Studies for these routes have been completed. However, actual construction of the U.S. 70 Relief Route is not programmed due to cutbacks in Federal Highway Funds. The U.S. 285 Relief Route is moving forward but will probably not be completed until 1986. In the meantime heavy truck traffic must travel through the heart of downtown Roswell on Main Street (U.S. 285) and Second Street (U.S. 70). The capacities of these streets has been exceeded and the potential for a major disaster in the downtown area increases daily.

A means to develop the relief routes must be found so that construction of these facilities can begin immediately.

In general the lack of direct access to interstate markets by means of an adequate highway system, airline service, and rail service inhibits the long term growth potential for the Roswell area.

99-979 O - 82 - 11

Public Facilities Statement

The City has identified needed improvements in public facilities such as water, sewer, street, drainage, and park and recreation needs within the area to better serve existing users as well as those users associated with the oil and gas industry.

Roswell has a facilities plan for a new sewage treatment plant and sewage collector lines. We have been trying to obtain federal and state funding for this project since 1975. The need for sewage improvements is aggravated by the large influx of people associated with the oil and gas industry most of which will be housed within the City of Roswell. Cutbacks in Federal allocations for sewage facilities have had severe impact on the city's ability to deal with this problem. The cost of needed improvements to the sewage system exceed $32,000,000.

Expansion of the water system and obtaining more water rights for city use will be needed to accomodate the increased population.

The schools, parks, recreation, hospitals, and general welfare systems of the City do not have the resources to accomodate the needs of the oil and gas industry.

Unfortunately, we find that most of the tax revenues generated by the oil and gas industry go to the state and federal governments and very little revenue comes to the local area to address public facilities needs.

Housing Need Statement

Housing shortages are a major impact of the large scale oil and gas development occurring in this area. The City is responsible for undertaking planning efforts to assure economically efficient expansion of the housing supply. The need for sufficient standard-priced housing units is an objective which is difficult to resolve given current

national economic reflections. The existing housing supply in Roswell is exhausted, and many of the older homes are substandard or deteriorating. Moderate-income dwelling units are needed immediately in order to house the community's expanding population.

Economic Development Statement

Attraction and expansion of the general industrial and commercial job base with clean, low water-using employers is critical to the growth and economic well-being of this area. The general household income in Roswell provides a relatively low level of disposable income which adversely impacts local government revenue resources and thereby the City's capacity to fund needed public facilities. Consequently the City is seeking to maintain a balanced growth of all economic sectors in order to avoid the "boom and bust" cycle and its impact on the socioeconomic system.

Taxes and royalties from the oil and gas activity around Roswell are expected to generate $1.5 billion dollars in revenue to the state and federal governments. Unfortunately there are no provisions for any part of these taxes and royalties to be used in the local area to address the impacts caused by the oil and gas industry.

We are hopeful that some means can be established to return a part of the tax and royalty payments to the federal and state government to Chaves County and the City of Roswell to help mitigate the socio-economic impacts of the oil and gas industry in this area.

BIOGRAPHICAL SKETCH

Bill Armstrong, Jr.

Native of Roswell, New Mexico; President of Armstrong Construction Company which has been in business since 1925.

Attended Roswell schools and graduated from New Mexico Military Institute High School and Junior College. Holds Bachelor's Degree in Civil Engineering from Lehigh University, and is a Registered Professional Engineer in the State of New Mexico.

Recipient of 1979 Outstanding Young Men of America Award.

Community activities have included serving on Boards of Directors of United Way, New Mexico Military Institute Alumni Association, YMCA Foundation, Security National Bank of Roswell. Currently holds position of Chairman of the Board of Roswell Chamber of Commerce after five years service on the Board of Director.

Bill Armstrong, Jr. and his wife, Patricia, reside in Roswell with their two children, Scott, 13 years old, and Ami, 9 years of age.

Mr. SKEEN. Thank you very much, Mr. Armstrong. I want to thank the entire panel for their fine testimony. I think it illustrates exactly what this committee had in mind. When we are dealing with problems of resources, there are always the negatives that offset some of the bloom in this, and we want to hear about that as well as the advantages. I think that you have all explained them well.

I would like to ask, would you all like to break just a moment and stretch a little, and we will get into the questions? I think that might be a good idea. This sitting for long periods of time is only good for people in Congress, not for active people. Let us take about a 5- or 6-minute break.

[Recess.]

Mr. SKEEN. The committee will be in order.

I hate to cut your respite a little short, but let us get to this. I appreciate your attendance. The staff tells me this is probably one of the better attended hearings that we have ever had, and I want to compliment you folks in New Mexico for the fine job of turning out. If you are Texans, we are delighted to have you. You come and keep us green.

I would like to start by questioning first Mr. Hanagan. In your testimony, you were talking about the number of active wells and completions and so forth. What is the dry hole percentage for New Mexico, just as an indication of how productive the exploration has been in this area?

Mr. HANAGAN. Mr. Chairman, as I recall, the dry hole percentage now is running around 10 to 12 percent of all the wells drilled. However, in wildcat areas it runs about 40 percent dry, 4 out of 10 wells drilled are dry in wildcat areas.

Mr. SKEEN. How does this compare with other productive areas outside the State of New Mexico?

Mr. HANAGAN. I think it is pretty close to Wyoming and the other areas comparable to New Mexico.

The dry hole ratio is not as large nowadays as it used to be because of the higher price of oil and gas and, therefore, more wells can be completed and be commercially productive, whereas in the old days they would have been abandoned.

Mr. SKEEN. The technology is also better?

Mr. HANAGAN. Yes, the technology is better and the price is better.

Mr. SKEEN. Does your organization do anything to help facilitate the disagreements or some of the problems that we have between communities or individuals such as Mr. Martin and the other ranchers, on some of the problems? I do not want to put your head in a noose, Mr. Hanagan, but I know this has been an ongoing problem since New Mexico became an oil- and gas-producing State, and it occurs time and again when we open new areas. I was given to understand that your organization has done some work.

Mr. HANAGAN. Yes, Mr. Chairman, over many, many years in the land disturbance problem—it is not new; since production started in 1921 there have always been running engagements with other land users over disturbance. Over the years the association has acted, and within the last 2 years we have met several times with ranchers and others and will continue to do so to try to work out these problems.

Mr. SKEEN. Thank you.

Mr. Martin, a question that I think would be significant is this: I think it is perceived by people who do not understand land operations in New Mexico, particularly those that are in the ranching business and have been for long periods of time, there is a perception that oil and gas development is beneficial to the agricultural community because of royalties and so forth. If I might ask you a personal question, and I know this would be unforgivable to anybody that was an outsider, I am doing this on friendship: Do you have any royalty on your operation?

Mr. MARTIN. No. I have a lot of mineral rights leased out. There have been no wells drilled on my ownership. All of them have been on Federal or State minerals.

Mr. SKEEN. You do have some minerals?

Mr. MARTIN. Yes, sir.

Mr. SKEEN. What in your estimation is the amount of private mineral acreage there is in the ranching area you are involved in?

Mr. MARTIN. In my area less than 25 percent of the minerals are owned privately. The rest are owned either by the State or Federal Government. There is a lot more surface land that is owned privately, but the mineral rights are less than 25-percent privately owned.

Mr. SKEEN. Do you receive any damages from operators for any kind of surface damage returned to you?

Mr. MARTIN. I do when they cross my private lands, I receive that. I do not receive anything on Federal.

Mr. SKEEN. The reason I asked the question is that it is so hard to describe or to draw a picture of what the existing situation is in

the State because the lands are intermingled to such degree that there is very little mineral ownership so far as ranch operators in general. I would have to say most of the minerals, I think going back to 1918, were retained by the State when they sold their lands. The Federal Government never relinquished any mineral rights that I know of. So that keeps the private ownership mineral base to a small amount. When you have this activity you suffer the surface damage, and it is very difficult to calculate the kind of damage. It creates a problem between operators in the oil business and the ranchers.

Is there a spirit of cooperation from oil operators with land operators in trying to overcome these problems?

Mr. MARTIN. In a large sense we have recently got to working in better cooperation on everything. One of our problems has been we paid on State land, we have to pay one-third inheritance tax, and—one-half on State and one-third on Federal lands.

On the paper we own the lease but it can be taken immediately, and we lose the revenue on our cattle by the activity in there due to the harassment at all times to the cattle even with our comingled land.

Mr. SKEEN. Just in the everyday things, leasing for cattle or for sheep grazing, things of that kind, are they a source of irritation to oil and land operators?

Mr. MARTIN. Yes, they are. Various ranches have different breeds of cattle or sheep. They prefer to keep them that way. If you have high-grade Herefords and your neighbor has Brahmas, you do not want them crossed. It is expensive and hard to hire help to come out and separate the two ranches when a gate is left open.

Mr. SKEEN. Thank you, Mr. Martin.

Secretary Turpen, last year was the year of greatest increased oil and gas activity, I assume probably the largest year of increased oil and gas revenues. As I understand it, what kind of funding level was given the community assistance program?

Mr. TURPEN. Mr. Chairman, as a matter of fact in the last legislative session zero was given in new money to the community assistance council funding, due to problems with amending legislation that fell through at the last minute. We anticipate it will be funded again in the next session. I did not particularly want to talk about that.

Mr. SKEEN. I did understand that this thing is in the process of being recommended; is that correct?

Mr. TURPEN. Yes.

Mr. SKEEN. It should not be a problem because as Mrs. Hellums pointed out, the impact occurred rapidly and it has taken 2 years to get a response.

Mr. TURPEN. Mr. Chairman, in fact that is true. It has made their problems, all community problems much worse because we cannot do anything by way of new projects. We have ongoing monitoring projects only. There are a series of hearings going on around the State, one on grants, there will be one in Hobbs this summer, concerning how to remedy the situation, and improve on existing legislation to allow greater numbers of communities to become eligible for this assistance. I did not go into the criteria for eligibility, and we can put it in the record if you like, Mr. Chairman.

Mr. SKEEN. Yes, I would like to have that.

[See Appendix II:]

Mr. SKEEN. Considering the levels of return, is there a dedication from the State of New Mexico to the community assistance program for future years?

Mr. TURPEN. Mr. Chairman, I believe so. We are going to work very strongly to see that there is funding once again. I believe the communities will be very strong behind that program. I think we will see it again. It was one of those things that happens late in the legislative session, sir.

Mr. SKEEN. We have the same problems at the Federal level. I do not want anybody to think that the Feds were all by themselves in doing things of this kind.

Ms. Hellums, how much Federal land do you have in Chaves County, and how much PIL money, payment in lieu of taxes, as you know. We have had a terrible problem, an ongoing one in Congress because payment in lieu of taxes is a unique kind of a situation in which Western States are granted money because of the high percentage of ownership of lands by the Federal Government in the States. These payments are made to counties directly. New Mexico is impacted heavily in that area because some of our counties have as much as 70 percent of the land that belongs to the Federal Government. The idea Congress has is that in some way with this great oil and gas activity we can compensate counties in the Western States by letting them have more or cede directly to them the oil and gas moneys.

This flies in the face of the fact that the Federal Mineral Leasing Act and the rest says it has to go to the State first and it is not sent back to the counties on that basis.

We have a hard time convincing a lot of folks from the East in the Congress that this is not just a dead giveaway to Western States. How severely have you been impacted in Chaves County?

Ms. HELLUMS. We have approximately 30 percent Federal lands in Chaves County.

Mr. SKEEN. How much is that in money? Say go back 2 years ago when you received full PIL money.

Ms. HELLUMS. Right now we are receiving about $860,000.

Mr. SKEEN. Was it more than that 2 years ago?

Ms. HELLUMS. Yes.

Mr. SKEEN. You did take a cut.

Mr. CURTIS WOLF. Mr. Chairman, I was not here 2 years ago, but I do not think there was a cut. I just cannot answer that.

Mr. SKEEN. There was controversy when we talked about reduction of PIL moneys. They were going to zero it out. We got the Secretary of the Interior to hold it at 70 percent.

Ms. HELLUMS. I believe we were full-funded.

Mr. SKEEN. You were.

Ms. HELLUMS. We were. They have not cut us at this point.

Mr. SKEEN. They have not cut you; all right. Let me ask you, you mentioned the new sanitary landfill cost you $240,000 or what?

Ms. HELLUMS. Yes.

Mr. SKEEN. What does that unit of land cost per acre?

Ms. HELLUMS. Our land costs are approximately $31,000 for the land. The additional costs are for manpower and equipment.

Mr. SKEEN. That is not all land cost.

Ms. HELLUMS. That is correct. We are negotiating—we found some State land down south, but that fell through.

Mr. SKEEN. You can get any help you need, Dorothy. I appreciate your speaking up. Go ahead if you have somebody who can make a contribution to the response.

Ms. HELLUMS. The other is manpower and equipment.

Mr. SKEEN. OK. That I think illustrates, too, what the problem is, that once you get into one of these systems, you have to fund the full thing, and you cannot go with just half a loaf or try to economize.

Ms. HELLUMS. Right. All we have now is a piece of equipment that we use on the landfills. Because of the increased activities up north, we have had to leave the piece of equipment on the north landfill. So we have not been able to properly service our landfills in the southern part of the county. Those communities down there, Dexter, Hagelman, and Lake Arthur have no tax base because the people who shop come to Roswell, so they have no gross receipts tax base. That is how the cities operate. So they look to the counties for their landfills.

Mr. SKEEN. Mr. Armstrong, would you give me a rundown on what happened in the Roswell area on this air carrier service as an example over the last few years?

Mr. ARMSTRONG. Well, years ago we were even supported by Continental Airlines, but that was back in the DC–3 days, and we have since had a number of carriers in the area come and go. The last jet service we had was Texas International. I think they suspended operations here about 4 years ago.

Since that time we have been serviced by a local carrier, Air Midwest, they are certified. They give us adequate service to Albuquerque and have recently started service to Midland. There are a good number of people who cannot fly that size of an aircraft and of course that cost has become prohibitive for many people, also.

Texas International recently announced that they were bringing a flight in on an overnight basis, and our latest communication with them has indicated that they will not until the current economic conditions of the airline industry improve.

Mr. SKEEN. How do you feel that deregulation of the airline industry affected this?

Mr. ARMSTRONG. I do not know how the airlines feel; I know from a consumer standpoint it has been excellent. The market has opened up. We have fairly cheap air fares on most major routes. The people who have suffered are those such as ourselves in the smaller communities who have a substantial level of air traffic that would go if the proper service was in here.

The service that we now receive is just not adequate to support what we think is a growing economy. The level of boardings has decreased dramatically since we lost our jet service. Our level of boardings I think has decreased by well over 50 percent since we lost our jet service.

Mr. SKEEN. The commuter interested communities then feel the adverse effects of deregulation that allowed the major airlines to leave. I know we have tried to attract several airlines, but it is important, because this has happened all over the United States. In

an area such as ours, I hear complaints of people who know about the oil and gas activity and the impact they have business interests. They complain as my friends in the Congress do that they cannot get to Roswell too easily, but I think that as you say, deregulation in the airline industry in itself has been beneficial. However, it has had an adverse effect on smaller communities such as ours.

Let me ask you this, and anybody on the panel can answer. The benefits that we have had from energy production in the overall sense have been a great benefit to the State, because we educated an awful lot of youngsters in this State. We are unique in that sense because most of our educational funding for the State comes from State sources, which I think Pete Hanagan has explained well, derived from the oil and gas industry.

But for the small cities, the livestock operators and so on, there have been tremendous problems, nightmares, involved with assimilating and accepting the kind of growth that is involved. Have you got any suggestions to those of us who are in Congress on how we can help? Now, I know we have our limitations and we recognize them every day and we display them probably better than anyone, but if you have any suggestions on how we can help with legislation or with just a little representation to the right bureaus and so on, because they react to this, how to get help. We fought the PIL fight, we will stay with it hard and fast, because we think it is essential that counties who have anywhere up to 70 percent of their land belonging to the Federal Government, that without that help, or even to summarily reduce it without warning, would leave us in a great sea of difficulty.

Please give any suggestions to us or to each other on how to make this work a little better, make it more workable. I know you need the truck bypass in the city of Roswell; I know that the legislature considered this, and I will not put it on Charles' back because he is not the road department, but I know there are several other things we need. We have other communities impacted in similar ways, and we have found no answers yet.

The city of Grants, when it was going full blast as a uranium-producing community, the main street was being torn up day after day after day, there was so little the municipality could do. But do you have any suggestions that I could take back? I would appreciate it.

Mr. TURPEN. Mr. Chairman, just if I might, a couple of comments. It will be nothing new to you, but I would like to put it in the record. I think for example, your support in fighting changes that are being contemplated now in formula funding of various kinds of Federal assistance to States and localities where there is a move on to change the approach from a per capita base measure to a representative tax system measure.

That is dangerous for States in the West. There are facts and figures available where that would mean extreme harm to the State of New Mexico, because a change in that formula to a representative tax system approach would cause significant reductions in the amount of money flowing to this State.

Mr. SKEEN. What you are saying is, in any system like that, where you have low population, that works a disadvantage on our situation.

Mr. TURPEN. That is correct. And you heard the arguments about the blue-eyed Arabs of the West and somehow we are a threat to the eastern communities trying to take so much in the way of severance taxes.

I think you have heard today that there are serious impacts that affect those areas where the energy is produced. We have to take on those impacts using our own resources, attempting to get help back to the communities. Those impacts are immense and they endure through the years, they endure after the oil and gas is pumped out, after the ground is turned over to take out the coal and turned over again to take out uranium and we have to be able to defend ourselves here. So that attitude is extremely dangerous to us. It is simply unfair.

Just exactly how that translates into any one vote, I don't know. But we need information to the rest of the country. The people need to know the things we have to cope with here. They have to know what it costs to protect our environment and get that energy to the rest of the Nation.

Mr. SKEEN. Dorothy.

Ms. HELLUMS. Thank you. Mr. Chairman, I have discussed this with a lot of people in the county within the government itself, we feel it will be very helpful if we could receive initial funds early, there is such a lag time otherwise. People don't realize that. The impacts are right now. They are on our roads, they are on all our other systems including the offices down at the courthouse, and yet we don't receive any funds until 3 to 4 months after that as is in that pipeline. If we could get that back direct to the county. By the time it goes to the Federal and State and comes to the county, though, it is a real problem. That goes along with what the President's program is, you know, let's return this directly so we can handle our own problems.

I believe that Senator Domenici has this week introduced a bill that would return those funds to the State, the State would take their portion out and then send it to the Federal Government. That would help tremendously. More than that, if we could get it brought down even further, just to give you an example, if I might, that I just received this morning. Our fiscal year being July 1 of 1981 through June 30, 1982 I will tell you just about the royalties from the Federal lands of the Abo gas.

Mr. SKEEN. That comes directly back to the county.

Ms. HELLUMS. Yes. The moneys that came back to the States just from those lands in northwest Chaves County was $3,190,951. That is 50 percent of what the Federal Government got. Of that, we received $662,000. We can't operate on that. The many impacts are here and yet the money is everywhere else. That is our problem. If we can alleviate somehow the flow of the money, I guess without money we can't offer services, you know. We can't make our people happy.

Mr. SKEEN. What category do those funds come back to you in?

Ms. HELLUMS. We have oil and gas production; that is how it is labeled; and oil and gas equipment. It is how it is based; on the

actual production and based on the actual equipment in the county.

Mr. SKEEN. Are those Federal lands or all?

Ms. HELLUMS. On all of it. $662,000 is the total we got from all of our oil and gas production throughout the whole county, the figures I gave you that returned from the State was only on Federal lands in the Abo formation.

Mr. SKEEN. Sounds to me like you have a problem with formularization in this somewhere along the line, either that or I don't understand. I would have to go through the entire process of how it is collected and disbursed, and I am not prepared for that today. But that is another problem.

It seems every State probably has a different way of formularizing the returns from the mineral leasing money. That bolsters the argument that we talked about on the bill because they are handled on a different plane in every State, almost.

Mr. MARTIN. Mr. Chairman, we are just getting clear of our energy shortage from years past with the large increase in gas and everything. You don't want to see us with the same shortage in the agriculture industry in the near future of food for the people.

If we cut production down, for example, this year we are only running 400 year links; I have 150. Due to the bad economy and oil and gas production in there I cannot continually operate under those terms but I can't operate at a deficit on it, either.

If we wake up here in a few years and all of agriculture is owned by the large corporations then food will be at their discretion. You pay whatever they ask for it. It is not produced as readily as what I know we produce it now.

Mr. SKEEN. That is one of the predicaments the Congress finds itself in. They are talking to the consumer about keeping food cheap and they are talking to the farmer about getting a better price. You know who ends up getting the best deal is the consumer, which is all of us; because they are the ones that do the most voting. But it is a strange thing. I understand the things you are talking about are the high interest rates, and I have a great deal of sympathy.

Since I am in the same business you are, however, I don't have the tax problem you have, so I understand perfectly what you are talking about.

That is why I am hoping there is some way that we can alleviate that kind of a problem and keep those irritations down between the energy producers and the food and fiber producers, because what they are trying to do is achieve the same goals.

Their purposes are the same. Of course, I know we get diverted because of our own peculiar interests, and I don't have any answer for you; I swear I don't. It would be nice to say I knew how to handle that and could give you a quick answer. I don't have that kind of quick answer. I do appreciate you highlighting what the problem is. The small ranching operators that are family oriented face some of the most troublesome of economic times.

I appreciate the input. I hope we get this message across to the folks back East so they have a little sympathy, too, for the kinds of things that we have to face up to.

Anybody else have anything? Anybody on staff?

Mr. LAMINA. I have a three-part question. Let's start with Mr. Hanagan. You mentioned in your testimony, Mr. Hanagan, the rapid pace of drilling activity for oil and gas in 1981. From testimony today, we have seen that trend has pretty much reversed itself in 1982.

I would like to know if you have any figures thus far for 1982 for just the amount of decrease in drilling activity in New Mexico.

Mr. HANAGAN. Mr. Chairman and Mr. Lamina, yes, my testimony was generally upbeat, showing what happened last year. Things are turning a little sour in the industry, and I think nationwide. But to show you what's happening here in New Mexico, I will use some of the criteria for judging how healthy a drilling industry is.

On January 1, 1982, just 6 months ago on a statewide basis, there were 158 rigs actively working in the State, as of July 22, there were 81. That is a drop of 49 percent in a 6-month period.

Here in southeastern New Mexico, there were 128 rigs, dropping down to 61, for a decline of 52.3 percent.

I might emphasize that especially in view of the testimony by the panel today. In Chaves County, January 1, 1982, there were 28 active rigs and now there are only 10.

For those of you interested in other areas of the State it's even worse in northwest New Mexico. In San Juan County as of January 1, 1982, there were 15 rigs active and on July 22, there were two rigs actively working.

Another criterion, the applications to drill or new locations, which indicate on the part of the producer how interested he is in future drilling. The current situation there is also not too bright. For the first 6 months of this year as compared to the first 6 months of last year, on a statewide basis there were 570 fewer applications to drill than in the same period last year, for a drop-off of 34 percent.

In northwest, that was a drop of 337 applications, for almost a 51-percent decrease in applications to drill. In southeast the dropoff has been 23 percent.

The final figure I would give the committee is with respect to production for the first 5 months of this year compared to the 5 months of last year. Oil production statewide is down over 2 percent, and gas production is down about 4 percent. That is significant in gas because gas production has held its own over the last several years.

So things are going down. I know if you walk around the streets of Roswell things are not anywhere as busy in the industry as it has been up through last year.

Mr. SKEEN. That will give us time to fix the roads.

Mr. LAMINA. I would assume by what Mr. Hanagan just said that that would decrease the revenues that the State would take in from oil and gas. How would that affect your ability to fund the CAC program and thus the aid needed in the counties?

Mr. TURPEN. Certainly to the extent production drops off it has a negative impact on revenues. We have the other side of the impact which is price increases, too, so I should point out that in our own projections, the best we can do over the next few decades, it appears that with reasonable expectations for increased prices we will in money terms get increases in revenues in the industry al-

though there is a point in the foreseeable future where we will have absolute decreases.

So the result is very definitely that it will impact our ability in this State to provide the communities with that impact assistance which they will need. I want to emphasize that impacts occur not only on an upswing but on the downswing.

The problem of timing that you heard some of here today, is critical. We are talking oil and gas but in the grants area we, if there is not a community impacted by energy development I don't know what is. It is flat on its back, Grant City. We have to be careful, and I hope you take the message back that energy producing States have long-term impacts to cope with not only on boom but on bust times of the cycle.

Mr. SKEEN. Thank you, Mr. Secretary.

While I am at it, I want to take this opportunity, you have some outstanding persons with you that are part of your group and I would appreciate if you would introduce them. If they have anything they would like to contribute to this, I would certainly think this would be an appropriate time to let them have access to this record.

Mr. TURPEN. Mr. Chairman, I would be pleased to. Sitting over here, Mr. Gary Carlson, assistant secretary of the energy minerals department, is very well versed in energy policy of this statement over a number of years.

Dick Stamitz is with me, he is deputy director of the oil conservation division. The people I mentioned earlier are involved with the drilling and regulatory efforts.

Don Gonzales is with me, who is our program manager for the community CAC program. He is the man that has made this a very successful program over the years and we will get funding back again, Mr. Chairman.

Mr. SKEEN. We certainly hope so. We put it on you a little today.

Do any of these gentleman have anything to add?

If not, unless anyone on the panel or in the group up here has anything further to ask, I want to close this down by saying to all of you that we will be accepting testimony for inclusion in the record.

We will ask unanimous consent that it will be added to the record.

Mr. SKEEN. For all of you that have had prepared statements, we will put those in the record as you had them prepared. I appreciate the summarizations.

I want to thank you all again, you and the folks that came as witnesses. I appreciate the trouble and time and the effort and expense that it takes to have you here.

Let me explain, too, that I did not choose this as the site of this hearing. I just want to tell you this, that this community spoke for itself because it has the kind of situation that is of great interest to us in the Congress. I was delighted that they chose Roswell, N. Mex., as the site of this hearing, because I think that we have the kind of production that epitomizes what Americans can do best when they are left alone to take the risks that we take in private enterprise in our capitalistic efforts.

We do it very well, we suffer the tough times. This town has been through cycles of depression, and boom, through several decades that I am aware of, of course I am very young, having been born on Second and Michigan, and I have seen an awful lot of it. You were chosen because you are the epitome of a community that fits the kind of interest that we have, and that tells the story the best.

I appreciate the staff of the Science and Technology Committee, the chairman, Mr. Don Fuqua, who authorized the hearing down here. I appreciate it very much. I particularly appreciate the input you folks have made, and your attendance has just been marvelous. I appreciate you demonstrating to these folks the interest that you have. I want to say to the staff that you have just been outstanding.

This was all well put together. Bill Armstrong, I particularly appreciate you and the Chamber of Commerce. Where is our mayor? Is Pete here? Bless his heart, he does a lot of good work and stays quieter than any politician that I have ever had the privilege of serving.

Thank you for the hospitality. We appreciate that.

Mr. Reporter, you have done a great job. We appreciate that, too.

Thank you all very much. We appreciate you in the press and the news media being here. Thank you. We are adjourned.

[Whereupon, at 2:45 p.m., the subcommittee was adjourned.]

APPENDIX I

ADDITIONAL STATEMENTS SUBMITTED IN THE RECORD

1508 LONGWORTH HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
202-225-2365

COMMITTEES:
AGRICULTURE
SCIENCE AND TECHNOLOGY

SUZANNE EISOLD
ADMINISTRATIVE ASSISTANT

Congress of the United States
House of Representatives
JOE SKEEN
2ND DISTRICT, NEW MEXICO

DISTRICT OFFICES:
FEDERAL BUILDING
ROSWELL, NEW MEXICO 88201
FEDERAL BUILDING
LAS CRUCES, NEW MEXICO 88001
205 W. ALAMOGORDO
FARMINGTON, NEW MEXICO 87401

August 19, 1991

M

[illegible] one of my constituents
[illegible]ting in Roswell, New Mexico.

[illegible] of my constituent's letter is made
[illegible] our hearing.

Thank [illegible]tion in this regard.

Sincerely,

JOE SKEEN
MEMBER OF CONGRESS

JS:b

New Mexico Water Resources Research Institute

New Mexico State University ● Telephone (505) 646-4337 ● Box 3167, Las Cruces, New Mexico 88003-3167

August 9, 1982

Honorable Joe Skeen
1508 Longworth
House Office Building
Washington, DC 20515

Dear Representative Skeen:

I attended the hearing you chaired in Roswell on July 30, 1982, but did not have the opportunity to share some thoughts with you regarding potential impacts of enhanced gas and oil recovery. I congratulate you on your [illegible] issue and on allowing for public and industrial input on the

As Acting Director of New Mexico's Water Resource Research Institute, I am particularly concerned about the potential impacts of enhanced resource recovery on water resouces. The following are some general remarks regarding the subject. I have also listed three references that address water and mineral resource issues in New Mexico for your information. Your comments can be classified in two broad categories; water quantity and water quality consideration.

Water Quantity Consideration

Water use in New Mexico associated with mineral resource development constitutes only a small percentage (4-5%) of the state's overall water use. The table below gives the mineral water requirements projected for two basins (reference 2) in thousands of acre-feet.

Basin	1970 [illegible]		1980*		2000		2020	
			With-drawals	Deple-tions	With-drawals	Deple-tions	With-drawals	Deple-tions
Pecos	9.4	6.5	40.3	11.2	40.2	31.0	60.1	47.3
Texas-Gulf	24.3	3.4	4.3	1.1	39.0	7.5	50.6	15.7

*Actual values (reference 3).

Petroleum secondary recovery is estimated (reference 1) to require an increase in new (fresh) water resources of from 17,769 Aft (1970) to about 20,000 Aft (2020). The major water uses are expected to be associated with crude oil secondary production. Estimates assume past technologies for recovery. Other technologies can use less or considerable more water (polymer techniques). In general, the feeling is that there is sufficient water to accommodate expected mineral requirements, but water will have to come from existing water rights. In the Roswell area, such rights are already fully appropriated. In fact, in the Pecos Basin, there is litigation pending regarding the Carlsbad Irrigation Distict's claim on water being pumped in the Roswell area. Since CID's rights predate Roswell's rights, CID wants all rights issued after 1947 disallowed so that CID can receive the water it is entitled to. Some 19,000 acres of irrigated farmland (125 individual right owners) in the Roswell area, and 6,000 acres (91 individuals) in the Fort Summer area could be affected.

New Mexico law allows for transfer of rights and of points of diversion as long as existing rights are not impaired. Such rights, however, will likely have to be purchased - this could be expensive.

Water Quality Consideration

The major water problem associated with secondary recovery technique may be quality related rather than quantity related. I am told that there have been some cases of contamination of overlying fresh water aquifers with brine (associated with oil formation) reinjected to the oil formation. Leakage of wells apparently allowed contamination of the fresh-water aquifer. As secondary recovery involving pressurized water injection occurs there may be even greater opportunity for contamination. This could occur both from leakage of wells drilled through the fresh-water aquifers or by the upward invasion of pressurized brine-oil layers to high quality aquifers. These may be especially true in well developed oil fields such as the Roswell area where older wells have been abandoned. These holes (even if now capped) may offer low resistance paths for pressurized saline water to invade good quality water. I understand that a suit claiming just such damage to a good quality aquifer has been settled against Texaco.

This area needs extensive research if we are to allow pressurized recovery while protecting our valuable water supplies. The issue is, of course, particularly critical to the Roswell area and the east side of New Mexico in general where water resources are limited. I, therefore, suggest that consideration of increased funding for such research be included in any federal package associated with enhanced oil and gas. recovery.

I hope you find these remarks useful. I will be happy to furnish additional information upon request. Again, congratulations on a successful hearing. The excellent turn out of citizens must have been very rewarding.

Sincerely,

George A. O'Connor
Acting Director

GAO/ya

99-979 O - 82 - 12

References

1. "Mineral Resources and Water Requirements for New Mexico Minerals Industries." New Mexico Bureau of Mines and Mineral Resources, Circular 138, 1973.

2. "New Mexico Water Resources - Assessment for Planning Purposes." USDI, Bureau of Reclamation, 1976.

3. "Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980." New Mexico State Engineer, Technical Report 44.

Statement of

Henry B. Taliaferro, Jr.

Executive Vice President

The GHK Companies

Introduction

Mr. Chairman, my name is Henry B. Taliaferro, Jr. I am Executive Vice President of the GHK Companies. GHK was among the first independent companies whose purpose was solely to explore for natural gas where only gas is to be found -- in sediments too deep to contain oil.

On behalf of GHK, I would like to commend you and the members of this subcommittee for your interest in examining the "natural gas option" as you evaluate alternative energy sources for the future. Most policy makers do not yet begin to understand the enormous positive contribution domestically produced, conventional supplies of natural gas can make to the nation's energy supply/demand balance. This contribution does not depend upon the expenditure of federal budget dollars nor does it depend upon loan guarantees or other indirect forms of taxpayer support. Instead, it depends upon the implementation of the wellhead pricing provisions of the Natural Gas Policy Act as intended by the Congress and upon the repeal of arbitrary and unnecessary federal, state and local demand constraints.

Mr. Chairman, no sector of our economy is today immune from the effects of the recession. It is evidence of the success of natural gas exploration companies that successful natural gas wildcats have continued to rise through mid-1982 despite the dramatic downturn in exploratory drilling for oil. And despite an anticipated reduction in the rate of growth in drilling for the second half of the year, experts predict 1982 will still be the second best year in the history of the natural gas industry.

As the national economy recovers, we can expect to see a commensurate increase in capital to develop America's truly enormous reserves of natural gas.

It is the reality of gas abundance I wish to explore with the subcommittee, beginning with a global perspective, a look at several fundamental changes underway in the U.S. natural gas industry, the reasons those changes are poorly understood and the implications for the world economy of gas abundance.

A GLOBAL PERSPECTIVE

Here in the United States natural gas -- methane -- has long been regarded as a high quality fuel. In most parts of the world, methane is regarded as anything but an ideal fuel -- it is expensive to transport by tanker and most countries lack pipeline and distribution systems. In contrast, oil can be transported and consumed easily and used to generate foreign exchange. These are powerful incentives to look for crude oil all over the globe. Except for a few nations there is little incentive to search for gas.

Despite the want of world wide incentives, proven global supplies of methane today approach 3,000 trillion cubic feet.

Potential reserves are many times larger: for Southeast Asia, form 4 to 11 times as large; for Africa 10 to 24 times as large, and; for Latin America 7 to 19 times as large as known reserves. In these three regions alone, potential methane resources could total over 10,000 trillion cubic feet according to UN estimates. Recent estimates by the U.S. Geological Survey suggest an additional 1,300 trillion cubic feet in the Volga-Urals and the West Siberian and Kara sea basins of the Soviet Union, and another 1 to 2,000 trillion cubic feet could be found in the Persian Gulf. As the USGS recently observed, these vast quantities have been identified with gas resources scarcely tested even in the heavily explored areas of the Middle East.

Skim any energy journal and you will find articles highlighting oil exploration activities in Africa, or Latin America or Mexico which discovered no oil, but found substantial supplies of natural gas.

By economic accident, as a by-product of the oil search, explorationists on every continent are literally stumbling onto the fact that our planet possesses an enormous wealth of methane.

As a result, even as methane consumption in the United States continues to decline, elsewhere in the world it is on the rise. Between 1974 and 1978, our country was alone among the 17 industrialized nations belonging to the OECD to decrease its use of natural gas. The AGA recently estimated between 1970 and 1982 world use of methane rose 43 percent.

Industrial use in Canada rose by over 30%, in Japan it was up 20%, in France up almost 50% and in Australia up almost 100%. In the centrally planned economies of the Soviet Union and Eastern Europe, the same phenomenon is underway -- massive increases in use of methane for electric power generation, and a doubling in industrial use in the USSR, Poland, Hungary and Czechoslovakia.

Between 1980 and 1981, world oil production fell, not only in the Middle East, but in Africa, South East Asia and North America as well. During this period, even in the face of the slowdown in world economic activity, gas production rose by nearly two trillion cubic feet.

By the end of this century, proven methane reserves will dwarf remaining petroleum reserves. The sheer abundance of gas supply is stimulating investment in more efficient technologies and methane is beginning to penetrate entirely new markets. With the benefit of combined cycle turbines, the Tokyo Electric Power Company is replacing 2 gigawatts of planned nuclear capacity with natural gas. Even in transportation, new conversion techniques, shortly to be operational, offer new efficiencies. In Italy, Canada and New Zealand, the development of methane powered vehicles is well underway.

But, the greatest growth potential lies in the emerging nations of the developing world. A year ago, a French consulting firm -- BEICIP -- in a study conducted for the World Bank examined this

potential. The report highlights the growing importance of natural gas as a source of energy in developing countries. In these countries, known natural gas reserves are much more abundant than known coal reserves. BEICIP predicts recent increases in natural gas prices and improvements in drilling techniques will spur discovery of entirely new reserves. The report also indentifies economic factors which favor methane as a source of energy supply -- including much lower exploration costs and significantly greater recovery ratios than for petroleum. Among industries identified by BEICIP as those best suited to use gas worldwide are: power generation, steel, petrochemicals, fertilizer pulp and paper, glass, ceramics, food processing, non-ferrous metals and more.

These emerging markets will provide incentives to launch in earnest the global search for natural gas.

AN AMERICAN PERSPECTIVE

Here in the United States three equally important changes are underway.

The first of these changes is the shift at the exploration and development end, from the old "oil and gas" business to the new methane industry.

Between 1975 and 1981, the structure of the natural gas industry changed dramatically. Production, share of proven reserves and new reserves added by the top 20 gas reserve owners declined sharply in this period. In contrast, production, reserve market share and new discoveries by independents steadily climbed. Let me site a few statistics:

- Reserve market share for the top 20 companies fell from almost two-thirds, to just over half of the nation's proven gas supplies.

- Production by the top twenty fell by over a fifth. Production by independents rose 40%.

- Net proven reserves of the top 20 plunged by 35 Tcf. Net proven reserves of independents grew by 9 Tcf.

Independents were discovering and producing significant new gas supplies, but until recently these gains were swamped by the losses of the majors.

This transition is fundamentally important. It means methane is no longer the stepchild of oil. The wellhead end of the gas business is passing fom control largely by major oil companies into the hands of producers whose objective is the production and sale of natural gas. We are now at the threshold of a new basic industry -- the methane industry.

Mr. Chairman, I am appending at the conclusion of my remarks a memorandum and two tables displaying the foregoing data and explaining the methodology used to prepare them.

The second change is the shift onshore in the lower 48 states from exploration for associated gas to exploration for new gas reserves where only gas is found. Onshore, the lower 48 states is mature as an oil province. But, it is a collection of world scale frontiers as a natural gas province. The vast majority of that frontier scale gas is found below 10,000 feet and most of it below 15,000 feet. Before the incentives permitted by the Natural Gas Policy Act, 98 percent of all drilling was targeted above 15,000 feet. As one moves from shallow to deeper sediments, one passes from the realm of oil to the realm of natural gas. Exploration of that realm gas only begun. Less than 3 percent of the deep sediments have been explored.

Yet, exploration which has already taken place reveals almost limitless potential for gas in deep sediments. The wildcat success rate in the Deep Anadarko Basin is more than triple the wildcat success rate nationwide -- roughly 2 out of 3 deep exploratory wells find methane. Nationwide, the reserves discovered below 15,000 feet average 10 times the size of the typical shallower well. Between 1976 and 1980, production of gas from below 15,000 feet increased by 10,000 percent. Based on the acceleration in present investment in new gas drilling, production will continue to rise geometrically between now and 1985.

Thus, we arrive at the third change underway in the methane industry: the transition from an era of scarcity to an era of abundant, reliable, and xpanding natural gas supplies. In provinces across the country -- the Michigan, Williston, the Gulf Trends, the Western Overthrust, probably in the Appalachians -- explorationists are discovering and will discover vast new supplies. This abundance is already bringing deep gas prices down, is the most reliable mechanism for keeping prices down, and will permit the methane industry to capture markets from oil.

For each of the three years U.S. investment, drilling and completions have achieved the highest levels in the history of gas exploration. New reserve additions have risen dramatically -- from only about half of annual use in the mid-1970's to 70% in 1979 and nearly 90% in 1980. Based on a survey of the 1981 annual reports of the top 20 gas reserve owners, 1981 reserve additions are likely to have exceeded production for the first time since 1968.

Some observers are tempted to ask if all this methane exists economically attractive and reliable alternative to oil, why do experts continue to talk about a temporary, recession-created bubble to be followed by steadily declining supplies?

The answer is three fold. First, oil based experience dominates the thinking of resource estimators. Little information,

uninfluenced by the oil experience, has yet been collected about trends in the methane production industry. Data which is available is often released piecemeal or only after lengthy delay. Second the structural change in the industry -- the shift from majors to gas independents -- has colored the perception of virtually all the experts about trends in natural gas supplies. Look at the top 20 energy companies and what they have experienced between 1975 and 1981 -- sharply declining reserves and production. Of course, they thought the outlook was grim. Third, the continuing clash of economic interests over wellhead pricing policy has diverted attention from the good news about trends in our industry. Under current law, new gas prices have risen rapidly and virtually all gas discovered since 1977 will be decontrolled in a little over two years. Given the amount of time it takes to buy leases, prepare sites, drill, complete and hook up new wells, new gas is de facto deregulated today.

The real issue is what to do about old gas prices. Today and until pre-1977 supplies are exhausted, price controls on old gas permit a higher incentive price for new gas with customers paying the average, or market clearing price.

There is no way to raise the price of gas discovered before 1977 without driving down the price for gas discovered after 1977.

If this is done, burner-tip prices will rise, markets will contract, incentives for new gas exploration will be reduced and our country will pay more for less gas.

The single most important step that must be taken to optimize incentives for discovery and production of methane is not to tamper with wellhead pricing policy, but instead to repeal outdated, costly and totally unnecessary U.S. government prohibitions on new industrial use of gas. The Fuel Use Act, incremental pricing and anti-industry provisions of the Public Utility Regulatory Policies Act are the vestiges of an era that is past. They must be repealed. With unrestricted access to markets and assuming the economic recovery vital to all sectors of our economy, the methane industry has the capacity by the end of this decade to eliminate oil imports entirely. Just consider the benefits to our economy and to the world economy. Our planet is divided into nations which are petroleum haves and have nots. Natural gas is found virtually all over the earth. The abundance and pervasive distribution of methane supplies can eliminate the potential for economic shocks caused by energy supply interruptions. Imagine the improvement in world economic performance which might have been achieved in the last decade, had it not been for the price shocks and economic upheaval caused by the 1973 embargo and later the shut off of oil production from Iran.

Daniel Yergin and Martin Hillenbrand of Harvard, in a recent study entitled, Global Insecurity tallied up the costs to the seven largest industrialized nations from the 1973 and 1979 oil

price shocks. They found:

> "The oil shocks cost these countries $1.2 trillion in lost economic growth. Cumulative inflation was almost three times as high in the aftermath of the oil shocks as before, and the average unemployment rate doubled."

Yergin estimates the unemployment rate rose by 10 million people due to the Iranian shut down alone.

Most importantly, consider the lessening in world tensions if a way were found to minimize the strategic consequences of war or revolution in the Middle East.

Finally we are all reminded from time to time of what a truly small and fragile planet we inhabit. Unlike coal, natural gas produces virtually no emissions to pollute the air and water of people living sometimes thousands of miles away. Unlike nuclear power generation, methane users are spared the vexatious problem of dealing with hazardous wastes. Unlike synthetic fuels, methane supplies can be produced with no direct or indirect taxpayer support. Unlike highly promising new technologies, including solar, which will be of enormous commercial importance in the next century, the age of methane is <u>now</u>.

Thank you.

ESTIMATE OF 1981 MARKET SHARES AND RESERVE ADDITIONS IN THE GAS PRODUCTION INDUSTRY

Background

GHK has conducted a comprehensive analysis of 1981 natural gas production, reserves, and reserve additions among the 20 largest owners of natural gas reserves. This data, which is available in the annual reports of the major publicly-held gas production companies, provides a statistically valid means of estimating 1981 natural gas reserve additions for the United States. This data also reveals a pronounced trend toward decentralization of market share in the gas industry.

Executive Summary

- Over the period 1975 to 1981, the 20 largest holders of domestic gas reserves saw their market share of proven reserves decline 35.1 Tcf (24% drop) and their gas production fall 2.6 Tcf per year (22% drop).
  - In 1975 the 20 largest owners of domestic gas reserves supplied 60.9% of U.S. gas production. By 1980 their market share of gas production had fallen to 46.6%.
  - In 1981 the 20 largest holders of natural gas reserves owned 64.0% of U.S. domestic reserves. By 1981 that percentage had fallen to 54.9%.
- Over the period 1975 to 1981, independent gas producers added 9 Tcf of gas reserves net of production. For independent producers, end of year 1981 gas reserves totalled 110% of end of year 1975 reserves.
  - While gas production by major producers fell 22% between 1975 and 1981, gas production by independents increased 40% (from 7.5 Tcf to 10.5 Tcf).
- Gas reserve additions for 1981 are projected to be in the range from 19 Tcf to 22.6 Tcf (99% to 115% replacement of production).
  - Contrasting 1980 with 1981, the top 20 gas reserve owners replaced 53% of production with reserve additions in 1980 and 87% in 1981. That is, these companies added 5.0 Tcf of new gas reserves in 1980 and 7.9 Tcf of new reserves in 1981.
  - If historical market concentration trends continued in 1981 -- i.e., a 1.3% decline in reserve market share by the top 20 companies -- 1981 U.S. total gas reserve additions will have equalled 22.6 Tcf (115% replacement rate).
  - If independent producers reserve additions in 1981 equalled their 1980 reserve additions -- a very pessimistic assumption given the success enjoyed by the majors -- then U.S. total reserve additions will have been 19.4 Tcf (99% replacement) in 1981.

MARKET CONCENTRATION IN THE GAS PRODUCTION INDUSTRY
(Tcf)

	1975		1979		1980		1981	
	Reserves	Production	Reserves	Production	Reserves	Production	Reserves	Production
Top 20 Companies	146.0	11.7	115.6	10.1	111.9	9.5	110.9	9.1
Total Industry	228.2	19.2	201.0	19.7	199.0	19.6	202.1[P]	19.6
Percentage owned by Top 20	64.0%	60.9%	57.5%	51.1%	56.2%	48.2%	54.9%[P]	46.6%

Note: P = projection.

Sources: Reserves data from Principal Findings of the U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves 1980 Annual Report (EIA, October 1981) for 1979-80 and from Reserves of Crude oil, Natural Gas and Natural Gas Liquids in the United States and Canada: 1975 (API, A.G.A. and COA, 1976).

Gas production from Monthly Energy Review: March 1982 (EIA, 1982).

NATURAL GAS RESERVES DATA BY COMPANY
(Bcf)

	Reserves 1/1/80	Reserve Additions	Production	Reserves 1/1/81	Reserve Additions	Production	Reserves 1/1/82
Exxon	17200	774	(1329)	16667	1452	(1215)	16924
Atlantic Richfield	13354	662	(472)	13546	280	(448)	13378
Standard of Indiana	8654	592	(812)	8434	1258	(835)	8857
Texaco	9593	(1034)	(994)	7555	236	(892)	6899
Sohio	6672	72	(44)	6705	40	(47)	6699
Shell	7065	737	(651)	7149	653	(664)	7139
Mobil	6498	168	(718)	6205	766	(661)	6310
El Paso	6174	127	(286)	6015	325	(286)	5980
Union	6038	185	(442)	5781	125	(433)	5436
Standard of California	5300	535	(456)	5344	400	(439)	5294
Subtotal (for 10 companies	86474	2810	(6203)	83347	5498	(5920)	82916
Gulf	3052	153	(662)	4543	244	(615)	4172
Sun	3195	280	(384)	3424	248	(381)	3296
Phillips	3656	38	(331)	3363	378	(320)	3425
Tenneco	3319	305	(408)	3259	373	(437)	3387
Cities	3197	39	(297)	2939	111	(301)	2749
Conoco	2681	264	(285)	2660	211	(269)	2602
Getty	2546	273	(313)	2003	193	(319)	2476
Marathon	2177	116	(164)	2129	62	(161)	2031
Superior	1891	317	(296)	1912	261	(288)	1886
Union Pac.	1463	390	(112)	1755	360	(118)	2002
Subtotal for top 10-20 companies	29177	2175	(3252)	28587	2441	(3209)	28026
TOTAL top 20	115651	4985	(9455)	111934	7939	(9129)	110942

Note: The ten largest gas reserve owners replaced 45% of their production with reserve additions in 1980 and 93% in 1981.

The 20 largest gas reserve owners replaced 53% of their production with reserve additions in 1980 and 87% in 1981.

APPENDIX II

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

1502 LONGWORTH HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
202-225-2365

COMMITTEES:
AGRICULTURE
SCIENCE AND TECHNOLOGY

SUZANNE EISOLD
ADMINISTRATIVE ASSISTANT

Congress of the United States
House of Representatives

JOE SKEEN
2ND DISTRICT, NEW MEXICO

DISTRICT OFFICES:
FEDERAL BUILDING
ROSWELL, NEW MEXICO 88201
FEDERAL BUILDING
LAS CRUCES, NEW MEXICO 88001
305 W. ARRINGTON
FARMINGTON, NEW MEXICO 87401

Se 32

le Don Fuqua

ittee on Science & Technology
burn
on, D.C. 20515

on:

osed please find remarks that I would like to include
the permanent Record of our hearing in Roswell, New Mexico
n July 30, 1992

Thank you for your onsideration on this matter.

With best regards.

Sincerely,

JOE SKEEN, M.C.

JS:b

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
525 Camino de los Marquez
Santa Fe, New Mexico
87501

BRUCE KING
GOVERNOR

September 2, 1982

The Honorable Joe Skeen
United States Representative
U. S. House of Representatives
1508 Longworth House Office Building
Washington, D. C. 20515

Dear Representative Skeen:

It was a great honor and I thoroughly enjoyed making the presentation before the Energy Development and Applications Subcommittee of the House Committee on Science and Technology held in Roswell, New Mexico on July 30, 1982.

I believe that there was a good exchange of information concerning the existing oil and gas developments in New Mexico, their effects on the environment and the State's citizens, and the state and federal governments' efforts to assist the industry in the public interest.

I hereby fulfill my promise to send you a copy of our current energy and mineral impact assistance program legislation, the 1981 Community Assistance Council Status Report, and an expanded summary of this program as a supplement to the testimony provided on July 30.

Should you require additional information or if I can be of any further assistance, please don't hesitate to contact me.

Sincerely,

Charles D. Turpen

CHARLES D. TURPEN
Secretary

CDT:lmd

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OFFICE OF THE SECRETARY

BRUCE KING
GOVERNOR
LARRY KEHOE
SECRETARY

525 Camino de los Marquez
Santa Fe, New Mexico 87501

THE NEW MEXICO COMMUNITY ASSISTANCE COUNCIL

1981 ANNUAL STATUS REPORT

Resource & Development Division

January 1982

CACRP2-D-1

COMMUNITY ASSISTANCE COUNCIL

A major vehicle in New Mexico's effort to assure strong healthy growth in energy and mineral producing areas of the State is through the Community Assistance Council (CAC). The Council was created under the New Mexico Community Assistance Act of 1977 and was directed to administer a grant program of financial assistance to energy and mineral impacted areas of the State.

The original 1977 Act included an appropriation of $ 10,000,000.00 from severance tax bonds proceeds for Community Assistance grants. In this manner, monies from severance taxes are returned to energy and mineral producing areas for their beneficial use.

Membership of the CAC consists of the Secretaries or their designees of the Energy and Minerals Department, the Health and Environment Department, the Department of Finance and Administration, and the State Planning Office. Also sitting on the Council are members appointed by the Governor, the number of which was increased from three to five by the 1981 Legislature. The 1981 CAC legislation also provided for districting of the State with each of the five appointees representing one district.

The Secretary of the Energy and Minerals Department serves as the secretary to the Council and staff members from the Energy and Minerals Department administer the Council's programs and assist in preparing for Council's deliberations. In addition, appropriate State agencies provide technical review assistance during the application process, at the planning and specification stages and for any contract changes required for Community Assistance projects.

In meeting the legislative mandate to develop a statewide impact assistance program, the Council has established application procedures, rules and regulations which it annually revises, adopts and files in accordance with the State Rules Act.

These rules and procedures includes provisions which address: 1) Legislative requirements for meeting eligibility criteria; 2) Application procedures and forms; 3) Procedures for review, evaluation and grant approval processes for determining funding allocations; 4) Acceptance process by means of grant awards and their terms and conditions; 5) Administrative procedures to assure compliance with all applicable laws and regulations; and 6) Monitoring and inspection processes to assure the timely and satisfactory completion of funded projects.

The Council further revised its rules and regulations in 1981 to comply with the legislative mandate that certain regulatory and procedural guidelines be adopted after public hearing.

Generally, the implementation process for construction projects involves reviewing and revising as necessary plans and specifications for the funded projects, securing matching funds, and establishing joint procedures where federal agencies are concerned. The projects are then put out to bid, contracts are awarded, and construction commences. This process may take up to eighteen months for simple projects and up to thirty-four months for complex construction projects such as water treatment plants. (See Flow Chart on Page 7).

The Council in 1981 traveled extensively to become familiar both with ongoing projects and existing impacted areas and with those critical needs which will constitute potential projects for future funding and new and emerging energy and mineral developments. The Council visited the northeast, the northwest, and the southwest districts of the State, but because of budgetary restraints travel to the southeast was postponed until 1982 when additional funds may become available.

The Community Assistance Council staff fulfilled a major undertaking in 1981 with the publication of "An Account of Resource Development in New Mexico - Community Needs to 1985" which involved close coordination both with industry and with political subdivisions affected by energy and mineral developments. The report was intended as an overview of the current situation and its impacts on the affected areas. Its format hopefully will

lend itself readily to appropriate updating as developments and growth-related conditions change.

Again, in response to legislative mandate, the Council continued to coordinate the State's impact assistance program with related federal programs. Several Community Assistance projects have been administered jointly by the Council and the Economic Development Administration, the Farmers' Home Administration, the Department of Housing and Urban Development, and, more recently, the Section 601 Program of the Coal Conversion Act.

Through the Community Assistance Program which has completed its fifth funding cycle, the State of New Mexico has attempted to face its responsibility as directly as possible. The Program as it exists has assured that a major share of the technical and financial assistance required in energy and mineral development areas is available.

CURRENT STATUS

The State's share of assistance to energy-impacted communities through the Community Assistance Program has grown to $34,475,000 in five years: $10,000,000 in 1977; $1,500,000 in 1978; $7,975,000 in 1979; $5,000,000 in 1980, and $10,000,000 in 1981. In addition, the 1979 Legislature appropriated $500,000 for advance planning/study grants for CAC projects to be financed from the 1979 severance tax bond fund through the New Mexico State Highway Department. Of that appropriation, $235,260 was funded in 1979 and 1980 with $264,740 reverting to the New Mexico Highway Department in 1981 as provided by the 1979 amendments. Another $150,000 in 1981 was allocated from the General Fund for planning grants. See the following Summary Table.

99-979 O - 82 - 13

SUMMARY TABLE

Year	Construction Project Appropriation	Planning Study Appropriation	Number of Funded Projects	Amount of Reverted Funds
1977	$10,000,000	$ -0-	32	$ -0-
1978	1,500,000	-0-	8	-0-
1979	7,975,000	-	25	-0-
	-	500,000*	6	-0-
1980	5,000,000	-0-	19	-0-
	-	-	5	264,740**
1981	10,000,000	-	32	-0-
	-	150,000	11	-0-
Total	$34,475,000	$ 385,260 (Excludes reverted funds)	116 Const. 22 Plng.	$ 264,740

Total Funds Committed to Date for Projects and Planning Studies are:

$ 34,860,260.00

Energy and mineral impacted communities continue to contribute their share toward alleviating energy development related impacts by raising taxes and bonding themselves as close to capacity as is feasible in their individual situations. The 1980 CAC funding cycle witnessed the Southwest section of the State becoming eligible for assistance because of expansion of the copper industry and the required self-help efforts being satisfied. And in 1981, carbon dioxide was included as a mineral eligible for consideration for CAC funding.

Included herewith are the following exhibits which will serve to present an overview of the CAC Program as it currently stands:

Exhibit A - Status of 1977 CAC Projects

Exhibit B - Status of 1978 CAC Projects

Exhibit C - Status of 1979 CAC Projects

Exhibit D - Status of 1980 CAC Projects

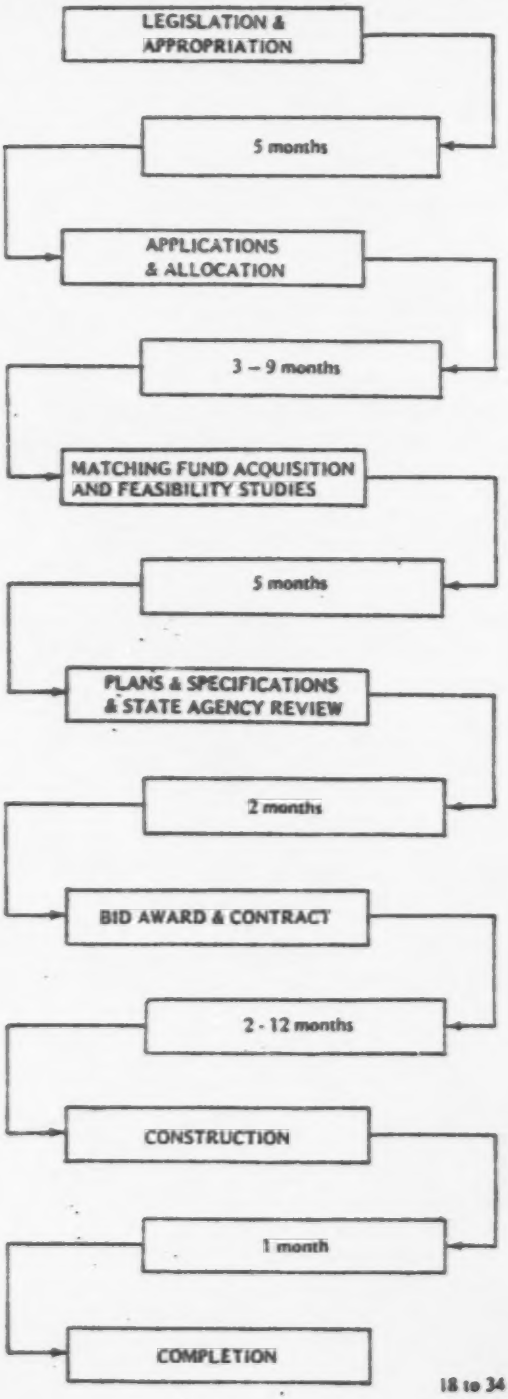
Exhibit E - Approved 1981 Funded Projects and Planning/Study Grants

Exhibit F - Distribution of Total CAC Funds by County and Geographic Area.

In summary, a total of 32 construction projects were funded in 1977, eight construction projects were funded in 1978, 25 in 1979, 19 in 1980, and 32 in 1981. Additionally, six planning studies were funded in 1979, five in 1980, and 11 in 1981.

Of the total 116 construction projects funded since the Program's inception, 60 have been completed with 56 remaining for staff administration and monitoring. In addition, of the 22 planning studies which have been funded, seven have been completed, and 15 remain for staff monitoring and administration.

COMMUNITY ASSISTANCE FLOW CHART



18 to 34 months from Allocation to Completion

March 12, 1982

EXHIBIT A

COMMUNITY ASSISTANCE COUNCIL

STATUS OF 1977 PROJECTS

PROJECT NO.	PROJECT DESCRIPTION	COMMUNITY	ORIGINAL AMOUNT FUNDED (1)	ACTUAL AMOUNT EXPENDED
77-3	Water System	Hobbs	$ 786,000.00	$ 786,000.00
77-4	Water System	Carlsbad	439,740.00	439,740.00
77-6	Sewer System	McKinley: Thoreau	200,000.00	195,660.93*
			* The project underrun of $4,339.07 was part of the $33,210.00 reallocated to CAC Project 79-28, Grants, by Council action on December 12, 1979.	
77-8	Sewer System	McKinley: Ya-Ta-Hey	288,500.00	288,500.00
77-9	Sewer System	McKinley: Williams Acres	180,500.00	180,460.43*
			* The project underrun of $39.57 was part of the $7,638.57 reallocated to CAC Project 80-1, Central, by Council action on April 29, 1981.	
77-10	Aztec Bridge	Gallup	625,000.00	625,000.00
77-13	Sewer Plant Improvements	Gallup	532,060.00	525,482.85*
			* The project underrun of $6,577.15 was part of the $33,210.00 reallocated to CAC Project 79-28, Grants, by Council action on December 12, 1979.	

PROJECT NO.	PROJECT DESCRIPTION	COMMUNITY	ORIGINAL AMOUNT FUNDED (1)	ACTUAL AMOUNT EXPENDED
77-14	Two Mil. Gal. Storage Tank	Gallup	$ 429,600.00	$ 429,389.40*
			* The project underrun of $210.60 was part of the $33,210.00 reallocated to CAC Project 79-28, Grants, by Council action on December 12, 1979.	
77-16	One Mil. Bal. Reservoir	Milan	39,147.00	89,147.00*
			* The project budget was increased by $50,000.00 transferred from Project 77-18 by Council action on March 29, 1978.	
77-17	Sewage Lift Station (Rehab.)	Milan	55,000.00	*
			* The project amount of $50,000.00 was transferred to Project 77-16 by Council action on March 29, 1978. Subsequently, the project was combined with CAC Project 77-18 for administrative convenience by Council action on July 19, 1978.	
77-18	Sewage Lift Station/ Collector Lines	Milan	125,000.00	130,000.00*
			* The project budget reflects the combined budgets of $125,000.00 from Project 77-18 and the $5,000.00 from Project 77-17 which remained after $50,000.00 was transferred from 77-17 to Project 77-16. CAC Projects 77-17 and 17-18 were combined for administrative convenience by Council action on July 19, 1978.	
77-22	Lobo Canyon Rd. Intersection	Grants	135,000.00	135,000.00

PROJECT NO.	PROJECT DESCRIPTION	COMMUNITY	ORIGINAL AMOUNT FUNDED (1)	ACTUAL AMOUNT EXPENDED
77-23	Street Improvements	Grants	$ 154,284.00	$ 154,284.00
77-25	Zuni Canyon Sewer	Grants	271,170.00	271,170.00
77-26	Sewer System, Lobo Canyon	Grants	600,000.00	612,061.98*
			* The project budget was increased by $12,061.98 transferred from Project 77-30 by Council action on July 19, 1978.	
77-28	Santa Fe Booster Station	Grants	136,000.00	136,000.00
77-29	Water Line Replacement	Grants	154,589.00	131,625.33*
			* Of the project underrun of $22,963.67, $15,364.66 was part of the $33,210.00 reallocated to CAC Project 79-28, Grants, by Council action on December 12, 1979, and $7,599.00 was part of the $7,638.57 reallocated to CAC Project 80-1, Central, by Council action on April 29, 1981.	
77-30	Water Line/Well to Storage	Grants	176,643.00	164,581.02*
			* The project budget was decreased by $12,061.98 which amount was transferred to Project 77-26 by Council action on July 19, 1978.	
77-33	Santa Fe Ave. Sewer System	Grants/Milan	77,000.00	77,000.00
77-34	Sewer System	San Rafael	414,000.00	414,000.00

PROJECT NO.	PROJECT DESCRIPTION	COMMUNITY	ORIGINAL AMOUNT FUNDED (1)	ACTUAL AMOUNT EXPENDED
77-36	Water System	Valencia: Mt. Taylor	$ 294,370.00	$ 290,430.31*
			* The project underrun of $3,939.69 was part of the $33,210.00 reallocated to CAC Project 79-28, Grants, by Council action on December 12, 1979.	
77-37	Water Project	Cuba	450,000.00	222,871.15*
			* The project budget was decreased to $225,000.00 when $225,000.00 was reallocated to Project 78-30 by Council action on July 19, 1978. The subsequent project underrun of $2,128.85 was part of the $33,210.00 reallocated to CAC Project 79-28, Grants, by Council action on December 12, 1979.	
77-49	Water System	Aztec	550,000.00	550,000.00
77-50	Water System	Bloomfield	347,000.00	347,000.00
77-51	Water System	Farmington	1,366,785.00	1,366,785.00
77-52	Water System	Farmington	250,000.00	250,000.00
77-53	Water System	San Juan: Lower Valley	196,300.00	195,650.03*
			* The project underrun of $649.97 was part of the $33,210.00 reallocated to CAC Project 79-28, Grants, by Council action on December 12, 1979.	

PROJECT NO.	PROJECT DESCRIPTION	COMMUNITY	ORIGINAL AMOUNT FUNDED (1)	ACTUAL AMOUNT EXPENDED
77-54	Water System	San Juan: Flora Vista	$ 111,582.00	$ 111,582.00
77-55	Water System	San Juan: Lee Acres	170,300.00	170,300.00
77-56	Water System	San Juan: Southside	170,300.00	170,300.00
77-57	Water System	San Juan: West Hammond	128,830.00	128,830.00
77-58	Water System	San Juan: Blanco	145,300.00	145,300.00
78-30	Sewer System	Bluewater	225,000.00	225,000.00*

* This 1978 project was funded $225,000.00 which was transferred from CAC Project 77-37, Cuba, by Council action on July 19, 1978. Subsequently, the project was approved by the State Board of Finance on August 14, 1978.

$10,000,000.00	$9,959,151.43
Reallocated Underrun of December 12, 1979	33,210.00(2)
Reallocated Underrun of April 29, 1981	7,638.57
	$10,000,000.00

(1) All projects and amounts listed under this column were recommended for funding by the Community Assistance Council on August 31, 1977, and approved by the State Board of Finance on September 16, 1977.

(2) Approved by the State Board of Finance on January 22, 1980.

March 12, 1982

EXHIBIT B

COMMUNITY ASSISTANCE COUNCIL

STATUS OF 1978 PROJECTS

PROJECT NO.	PROJECT DESCRIPTION	COMMUNITY	ORIGINAL AMOUNT FUNDED (1)	ACTUAL AMOUNT EXPENDED
78-2	Retention Dam	Farmington	$ 200,000.00	$ 200,000.00
78-3	Water System	Aztec	216,000.00	216,000.00
78-11	Water Tank	Gallup	75,500.00	75,500.00*
78-19	Sewer Plant Improvements	Grants/Milan	160,000.00	160,000.00
78-20	Sewer Trunk Line	Grants/Milan	150,000.00	150,000.00**
78-34	Water System	Questa	148,500.00	148,500.00
78-36	Water System	Raton	350,000.00	350,000.00
78-43	Water Tank	Lovington	200,000.00	200,000.00
		TOTALS	$1,500,000.00	$1,500,000.00

* 1977 funds in the amount of $429,600.00 allocated to CAC Project 77-14 were combined with CAC Project 78-11 funds to form one project and all project control documents are filed as CAC Project 77-14.

** 1977 funds in the amounts of $271,170.00 allocated to CAC Project 77-25 and $77,000.00 allocated to CAC Project 77-33 were combined with CAC Project 78-20 funds to form one project and all project control documents are filed as CAC Project 78-20.

(1) All projects and amounts listed under this column were recommended for funding by the Community Assistance Council on July 19, 1978, with prior approval of the State Board of Finance given on June 19, 1978.

PROJECT STATUS OF 1979 CAC FUNDING

March 12, 1982

EXHIBIT C

PROJECT CODE	PROJECT DESCRIPTION	COMMUNITY	AMOUNT FUNDED	AMOUNT EXPENDED	PERCENT EXPENDED	PERCENT CONTRACTED	PERCENT CONSTRUCTED	UNDER-RUN
79-1	Water	Aztec	$450,000.00	11,029.26	2	-0-	-0-	
79-2	Water	Bluewater	14,400.00	12,342.93	100	100	100	$2,057.07*
79-3	Water	San Juan Cty. (Lee Acres)	195,000.00	195,000.00	100	100	100	
79-4	Water	Bloomfield	183,500.00	183,500.00	100	100	100	
79-5	Sewer	Bloomfield	70,000.00	70,000.00	100	100	100	
79-10	Water	Carlsbad	900,000.00	900,000.00				
	Phase I		780,833.69	780,833.69	100	100	100	
	Phase II		119,166.31	119,166.31	100	100	100	
79-11	Bridge	San Juan Cty.	660,000.00	660,000.00	100	100	100	
79-14	Land & Impvmts.	Raton	20,000.00	17,939.96				
	Phase I		13,158.00	13,158.00	100	100	100	
	Phase II		6,842.00	4,781.96	100	100	100	2,060.04*
79-20	Street	Grants	143,000.00	143,000.00	100	100	100	
79-21	Sewer	Grants	500,000.00	-0-	-0-	-0-	-0-	
		Page Total	$ 3,135,900.00	$2,192,812.15				$4,117.11*

* Council may allocate this amount at a later date.

PROJECT STATUS OF 1979 CAC FUNDING

March 12, 1982

PROJECT CODE	PROJECT DESCRIPTION	COMMUNITY	AMOUNT FUNDED	AMOUNT EXPENDED	PERCENT EXPENDED	PERCENT CONTRACTED	PERCENT CONSTRUCTED	UNDER-RUN
79-22	Fire/Ambulance Bldgs.	Grants	$148,250.00	$140,837.50	95	100	100	
79-26	W.W.T.P. Impvmts	Grants	200,000.00	200,000.00				
	Phase I		21,800.24	21,800.24	100	100	100	
	Phase II		178,199.76	178,199.76	100	100	100	
79-27	Res. & Fire Security	Grants	135,000.00	124,316.30	92	100	99	
79-28	Street Impvmts	Grants	263,790.00	263,790.00	88	100	100	
79-34	Sewer	San Rafael	161,800.00	152,744.79	100	100	100	9,055.21*
79-38	Bridges SR 170	San Juan County	400,000.00	380,000.00	95	100	100	
79-39	US 64 Impvmts	Bloomfield	600,000.00	-0-	-0-	100	5	
79-41	Water	McKinley Cty.	50,000.00	49,655.17	100	100	100	344.83*
79-50	Street Impvmts	Taos	900,000.00	835,268.03				
	Phase I		67,675.76	67,675.76	100	100	100	
	Phase II		236,000.00	210,341.90	89%	100	95	
	Phase III		596,324.24	557,250.37	93%	100	88	
79-52	Sewer	Milan	230,000.00	13,413.60	.05	-0-	-0-	
		Page Total	$3,088,840.00	$2,160,025.39				$9,400.04
		Sub Total	$6,224,740.00	$4,352,837.54				13,517.15

* Council may allocate this amount at a later date.

PROJECT STATUS OF 1979 CAC FUNDING

March 12, 1982

PROJECT CODE	PROJECT DESCRIPTION	COMMUNITY	AMOUNT FUNDED	AMOUNT EXPENDED	PERCENT EXPENDED	PERCENT CONTRACTED	PERCENT CONSTRUCTED	UNDER-RUN
79-54	Sewer	Questa	$400,000.00	$ 55,664.30	12	-0-	-0-	
79-55	Street Imprvmts	Farmington	725,000.00	$ 685,672.90	95	100	95	
79-61	Sewer	Farmington	241,800.00	241,800.00	100	100	100	
79-64	School Office & Library	Farmington Schools	251,460.00	231,296.08	92	100	100	
79-65	Vocational Bldg.	Taos Schools	132,000.00	129,178.60	98	100	100	
		Page Total	$ 1,750,260.00	$ 1,343,611.88				0
		Total	$ 7,975,000.00	$ 5,696,449.42				$13,517.15 *

$\frac{\$\ 5,696,449.42}{\$\ 7,975,000.00}$ = 71% expended to date

* The Council may allocate this amount at a later date.

COMMUNITY ASSISTANCE COUNCIL

1979 Planning Studies *

November 30, 1981

PROJECT NUMBER	DATE APPROVED	COMMUNITY	PROJECT DESCRIPTION	CAC DOLLARS FUNDED	AMOUNT EXPENDED
79-9S	10-17	Cuba	Water System Improvements and Geotechnical Study	$ 55,000	$ 55,000.00
79-15S	7-18	Valencia County	Western Portion Valencia County Roads Improvements	20,130	20,130.00
79-36S	7-18	Taos County	Cerro Community Project	2,500	2,500.00
79-40S	7-18	Grants/Mt. Taylor	Mt. Taylor Sewer System	26,935	26,935.00
79-43S	7-18	McKinley County	McKinley County Road Improvements	10,000	10,000.00
79-50S	6-6	Town of Taos	Storm Drainage and Paving Improvements	27,195	27,195.00
			TOTAL	$141,760	$141,760.00
				(100% Expended)	

* Funds for Planning Studies were appropriated for the fiscal years 68th (July 1, 1979 through June 30, 1980) and 69th (July 1, 1980 through June 30, 1981) in the amount of $500,000 to be expended through the New Mexico State Highway Department.

Reverted to Road Fund $264,740.

PROJECT STATUS OF 1980 CAC FUNDING

March 12, 1982

EXHIBIT D

PROJECT CODE	PROJECT DESCRIPTION	COMMUNITY	AMOUNT FUNDED	AMOUNT EXPENDED	PERCENT EXPENDED	PERCENT CONTRACTED	PERCENT CONSTRUCTED	UNDER-RUN
80-1	Paving and Drainage Control	Central	$ 67,000.00	67,000.00	100	100	100	
80-5	30th St. Earthwork/ Road Site	Farmington	485,000.00	361,832.33	75	100	80	
80-8	Public Works & Maintenance Facility	San Juan County	385,000.00	345,926.70	89	100	100	
80-9	Paving District	Raton	413,730.00	386,185.77	93	100	98	
80-13	Raw Water Storage Site Acquisition	Aztec	25,000.00	4,517.98	18	100	100	
80-15	14" Water Line	Aztec	175,000.00	117,194.67				
	Phase I		117,194.67	117,194.67	100	100	100	
	Phase II		57,805.33	0	0	100	0	
80-17	Wastewater Treatment Plant Improvements	Grants	150,000.00	0	0	0	0	
80-20	12" Water Line	Lower Valley WUA	235,000.00	232,604.26				
	Phase I		187,085.24	187,085.24	100	100	100	
	Phase II		47,914.76	45,519.02	95	100	100	
80-21	Hudson St. Sewer Interceptor	Silver City	250,000.00	195,176.52	78	100	100	
80-24	Sanitary Sewer Line	Carlsbad	202,000.00	196,671.75	100	100	100	5,328.25*
		Page Total	$2,387,730.00	$1,917,199.98				$5,328.25

* Council may allocate this amount at a later date.

PROJECT STATUS OF 1980 CAC FUNDING (Cont'd)

March 12, 1982

PROJECT CODE	PROJECT DESCRIPTION	COMMUNITY	AMOUNT FUNDED	AMOUNT EXPENDED	PERCENT EXPENDED	PERCENT CONTRACTED	PERCENT CONSTRUCTED	UNDER-RUN
80-26	Water/Sewer Lines	Milan	273,666.00	160,006.11	58	100	80	
80-28	Storm Drainage and Paving	Taos	385,000.00	0	0	0	0	
	Phase I		39,175.76	0	0	100	88	
	Phase II		30,000.00	0	0	0	0	
	Phase II		278,485.17	9,162.74	3%	0	0	
	Phase IV		37,339.07	0	0	0	0	
80-32	Sanitary Sewer System	Questa	385,000.00	0	0	100	0	
80-34	Rehoboth Reservoir	Gallup	519,004.00	455,362.98	100	100	100	63,641.02
80-36	Water/Road Improvements	Thoreau M&S Dist.	200,000.00	28,922.40	14	100	0	
80-37	County Road I Improvements	McKinley County	215,000.00	64,514.30	30	100	100	104,116.98
80-41	County Road 15 Improvements	McKinley County	25,000.00	20,116.32	80	100	90	
80-52	Four Classrooms at San Rafael	Grant School Dist.	201,600.00	191,520.00	95	100	100	
80-53	Twelve Classrooms at Taos Jr. High School	Taos School Dist.	265,000.00	238,500.00	90	100	100	
79-10**	Water Phase I	Carlsbad	93,000.00	87,911.29	100	100	100	5,088.71
79-26***	Sewer Phase II	Grants	50,000.00	50,000.00	100	100	100	
		Page Total	$2,612,270.00	$1,306,016.14				$ 172,846.71*
		Total	5,000,000.00	3,223,216.12				$ 178,174.96

$\frac{\$3,223,216.12}{\$5,000,000.00}$ = 64.5% expended to date.

** Council approved a transfer of $93,000 from CAC Project No. 80-24 to CAC Project No. 79-10 Phase I.

*** Council approved a transfer of $50,000 from CAC Project No. 80-17 to CAC Project No. 79-26 Phase II.

COMMUNITY ASSISTANCE COUNCIL

1980 Planning Studies

March 12, 1982

PROJECT NUMBER	DATE APPROVED	COMMUNITY	PROJECT DESCRIPTION	CAC DOLLARS FUNDED	AMOUNT EXPENDED
80-10	September 24, 1980	Raton	Water Facilities Study	$22,000.00	$19,800.00
80-11	September 24, 1980	Bloomfield	Eastside Water Plant Study	10,000.00	9,000.00
80-29	September 24, 1980	Taos	Northeast Bypass Feasibility Study	24,000.00	21,037.50
80-33	September 24, 1980	Questa	Street Improvements Study	22,000.00	22,000.00
80-47	September 24, 1980	Aztec	Street Improvements Study	15,500.00	15,500.00
		TOTAL		* $93,500.00 (93% Expended)	$87,337.50

* Funds for Planning Studies were appropriated for fiscal years 68th and 69th in the amount of $500,000 to be expended through the New Mexico State Highway Department. Of this total, $264,740 reverted to the Road Fund on June 30, 1981.

PROJECT STATUS OF 1981 CAC FUNDING

March 12, 1982

EXHIBIT E

PROJECT	COMMUNITY	AMOUNT FUNDED	AMOUNT EXPENDED	PERCENT EXPENDED	PERCENT CONTRACTED	PERCENT CONSTRUCTED	UNDER-RUN
81-2	Village of Central	$ 71,807.00	$ -0-	-0-	-0-	-0-	
81-3	Town of Silver City	324,465.00	-0-	-0-	-0-	-0-	
81-4	City of Raton	1,500,000.00	-0-	-0-	-0-	-0-	
81-7	City of Farmington	500,000.00	-0-	-0-	-0-	-0-	
81-10	City of Grants	380,000.00	-0-	-0-	-0-	-0-	
81-12	City of Grants	300,000.00	-0-	-0-	-0-	-0-	
81-16	City of Grants	250,000.00	-0-	-0-	-0-	-0-	
81-19	Village of Bayard	234,000.00	-0-	-0-	-0-	-0-	
81-20	Union County	240,000.00	-0-	-0-	-0-	-0-	
81-23	City of Bloomfield	450,000.00	-0-	-0-	-0-	-0-	
81-25	City of Carlsbad	380,000.00	-0-	-0-	-0-	-0-	
81-26	City of Hobbs	520,440.00	-0-	-0-	-0-	-0-	
81-27	City of Hobbs	709,230.00	-0-	-0-	100%	-0-	
81-31	San Juan County	90,000.00	-0-	-0-	-0-	-0-	
81-32	City of Cuba	83,000.00	-0-	-0-	-0-	-0-	
81-35	Village of Milan	250,000.00	2,685.43	1%	-0-	-0-	
	Page Total	$6,282,942.00	$2,685.43				

PROJECT STATUS OF 1981 CAC FUNDING

March 12, 1982

PROJECT	COMMUNITY	AMOUNT FUNDED	AMOUNT EXPENDED	PERCENT EXPENDED	PERCENT CONTRACTED	PERCENT CONSTRUCTED	UNDER-RUN
81-37	San Rafael M&S Dist	$ 340,000.00	7,540.74	2%	-0-	-0-	
81-41	McKinley County	90,000.00	-0-	-0-	-0-	-0-	
81-45	McKinley County	400,000.00	-0-	-0-	-0-	-0-	
81-51	City of Gallup	306,000.00	-0-	-0-	-0-	-0-	
81-52	City of Gallup	145,600.00	-0-	-0-	-0-	-0-	
81-54	Town of Taos	140,000.00					
	Phase I	30,000.00	-0-	-0-	-0-	-0-	
	Phase II	110,000.00	-0-	-0-	-0-	-0-	
81-55	Taos County	120,000.00	-0-	-0-	-0-	-0-	
81-62	City of Eunice	154,000.00	-0-	-0-	-0-	-0-	
81-63	City of Lovington	400,000.00	-0-	-0-	-0-	-0-	
	Phase I Water Lines	200,000.00	22,737.79	11.4%	100%	15%	
	Phase II Water Tank	510,000.00	-0-	-0-	-0-	-0-	
81-64	Grant County	254,600.00	-0-	-0-	-0-	-0-	
81-69	Town of Clayton						
81-72	City of Aztec						
	Page Total	$3,060,200.00	$30,278.19				
	Sub Total	9,343,142.00	32,963.62				

PROJECT STATUS OF 1981 CAC FUNDING

March 12, 1982

PROJECT	COMMUNITY		AMOUNT FUNDED	AMOUNT EXPENDED	PERCENT EXPENDED	PERCENT CONTRACTED	PERCENT CONSTRUCTED	UNDER-RUN
81-73	Village of Questa		147,878.00	-0-	-0-	-0-	-0-	
81-76	Village of Questa		155,000.00	-0-	-0-	-0-	-0-	
81-77	Village of Loving		160,000.00	-0-	-0-	-0-	-0-	
81-78	El Valle de Los Ranchos Sanitation District		193,980.00	-0-	-0-	-0-	-0-	
		Page Total	$ 656,858.00	$ -0-				
		Total	$10,000,000.00	32,963.96				

COMMUNITY ASSISTANCE COUNCIL

1981 Planning Studies

March 12, 1982

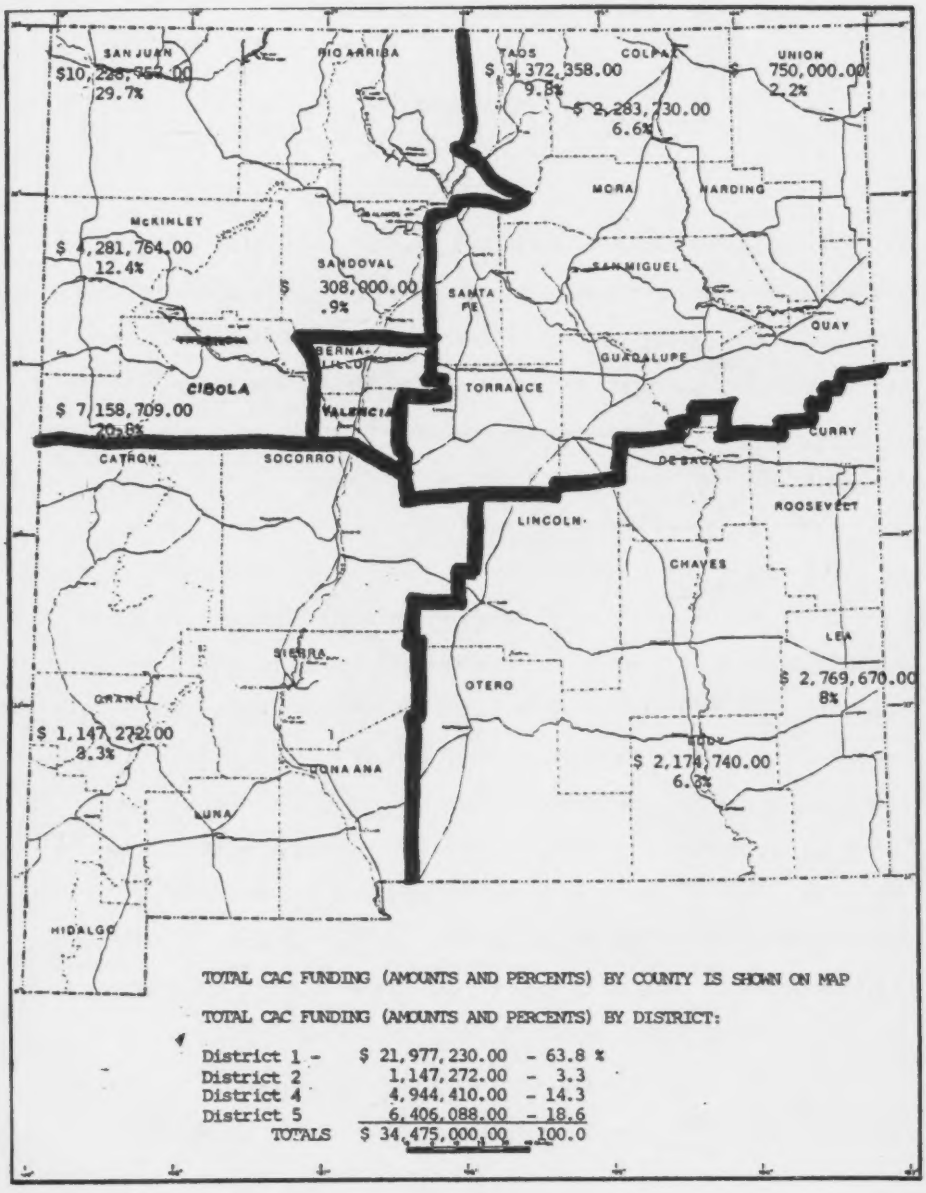
PROJECT NUMBER	COMMUNITY	DATE APPROVED	PROJECT DESCRIPTION	CAC DOLLARS FUNDED	AMOUNT EXPENDED
81-29	San Juan County	July 22, 1981	Hydrogeological & Merger Study	$ 12,000.00	$ -0-
81-33	Bluewater W&S Dist.	July 22, 1981	Storm Drainage	18,000.00	2,700.00
81-47	McKinley County	July 22, 1981	County Road 19	15,000.00	-0-
81-49	McKinley County	July 22, 1981	County Courthouse	3,700.00	-0-
81-53	Town of Taos	July 22, 1981	Right-of-Way Acquisition	22,000.00	-0-
81-56	Taos County	July 22, 1981	County Road Improvements	18,000.00	-0-
81-57	Taos County	July 22, 1981	El Prado Sewer	10,000.00	-0-
81-66	Village of Mosquero	July 22, 1981	Sewer System	18,000.00	-0-
81-68	Town of Clayton	July 22, 1981	Arterial Street Planning	14,800.00	-0-
81-71	City of Aztec	July 22, 1981	Critical Storm Drainage	9,000.00	-0-
81-74	Village of Questa	July 22, 1981	Water System Improvement	9,500.00	-0-
				$ 150,000.00	$ 2,700.00
				(1.8% Expended)	

EXHIBIT F

COMMUNITY ASSISTANCE COUNCIL

Funding by District and County

DISTRICT/COUNTY	1977 FUNDS	1978 FUNDS	1979 FUNDS	1980 FUNDS	1981 FUNDS
District One					
San Juan	$ 3,436,397.00	$ 416,000.00	$ 3,776,760.00	$ 1,305,000.00	$ 1,294,600.
McKinely	2,255,660.00	75,500.00	50,000.00	959,004.00	941,600.
Sandoval	225,000.00	-0-	-0-	-0-	83,000.
Cibola (Valencia)	2,857,203.00	310,000.00	1,796,240.00	675,266.00	1,520,000.
Subtotal	$ 8,774,260.00	$ 801,500.00	$ 5,623,000.00	$ 2,939,270.00	$ 3,839,200.
District Two					
Grant	$ -0-	$ -0-	$ -0-	$ 317,000.00	$ 830,272.
Subtotal				$ 317,000.00	$ 830,272.
District Four					
Lea	$ 786,000.00	$ 200,000.00	$ -0-	$ -0-	$ 1,783,670.
Eddy	439,740.00	-0-	900,000.00	295,000.00	540,000.
Subtotal	$ 1,225,740.00	$ 200,000.00	$ 900,000.00	$ 295,000.00	$ 2,323,670.
District Five					
Colfax	$ -0-	350,000.00	$ 20,000.00	$ 413,730.00	$ 1,500,000.
Taos	-0-	148,500.00	1,432,000.00	1,035,000.00	756,858.
Union	-0-	-0-	-0-	-0-	750,000.
Subtotal	$ -0-	$ 498,500.00	$ 1,452,000.00	$ 1,448,730.00	$ 3,006,858.
TOTALS	$10,000,000.00	$1,500,000.00	$ 7,975,000.00	$ 5,000,000.00	$10,000,000.



TOTAL CAC FUNDING (AMOUNTS AND PERCENTS) BY COUNTY IS SHOWN ON MAP

TOTAL CAC FUNDING (AMOUNTS AND PERCENTS) BY DISTRICT:

District 1 -	$ 21,977,230.00	- 63.8 %
District 2	1,147,272.00	- 3.3
District 4	4,944,410.00	- 14.3
District 5	6,406,088.00	- 18.6
TOTALS	$ 34,475,000.00	100.0

EMD'S IMPACT ASSISTANCE PROGRAM SUMMARY

FOR

CONGRESSIONAL HEARING

JULY 30, 1982, ROSWELL, NM

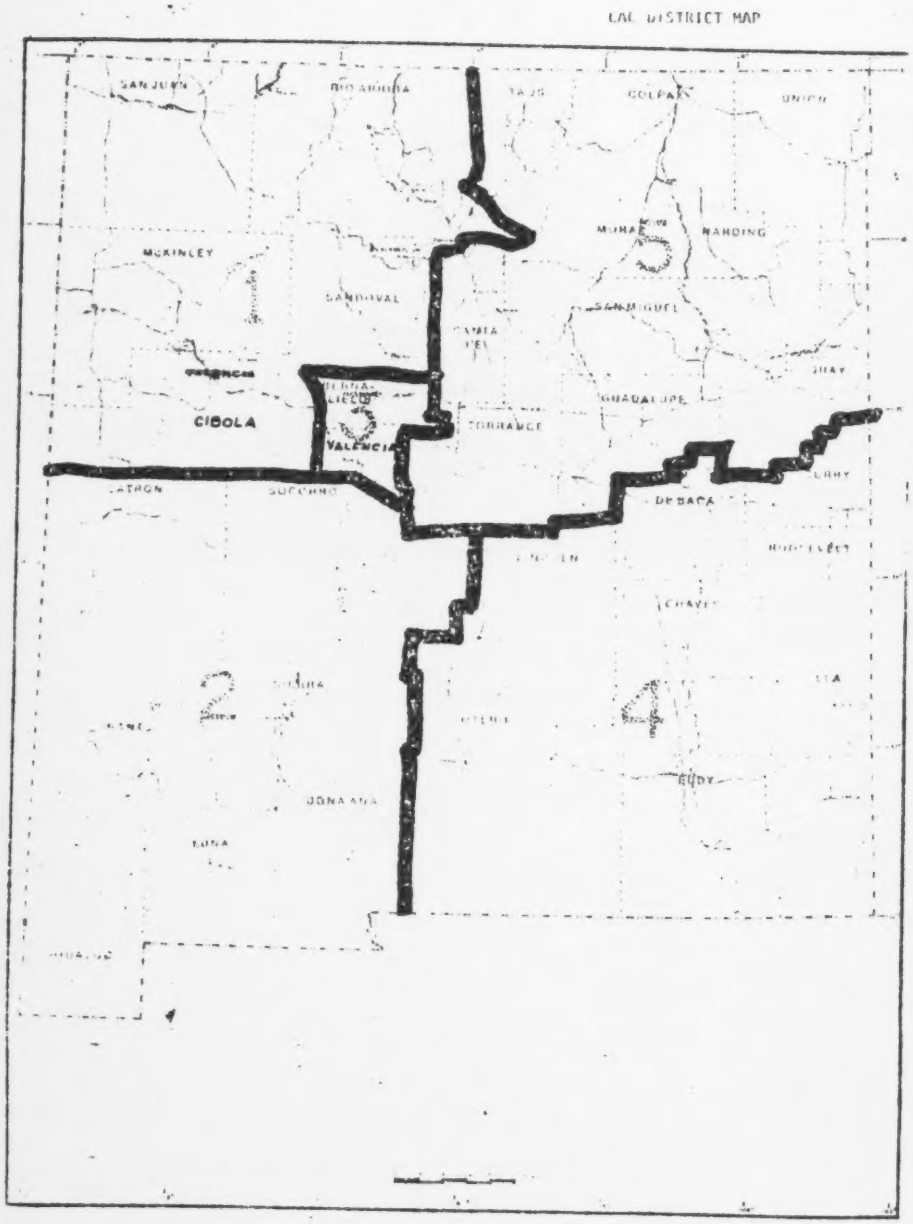
The New Mexico Community Assistance Council was created under the New Mexico Community Assistance Act of 1977 to administer a grant program of financial assistance "for solving the community problems arising from the rapid growth in areas near the development of mineral and energy resources."

Under the Community Assistance Program definition, an eligible grantee must be a political subdivision of the state.

Membership of the Council consists of the Secretaries or their designees of the Energy and Minerals Department, the Health and Environment Department, the Department of Finance and Administration, and the State Planning Division. In addition, five members are appointed by the Governor, each appointee representing one of five CAC districts as defined by the 1981 Legislature. (See CAC District Map).

Enabling legislation annually, except in 1978, has provided that financing for needed projects would come from the issuance of severance tax bonds. In 1978, monies were appropriated from the General Fund. Since 1977, a total of $34,475,000.00 has been appropriated for projects recommended for funding by the Council and approved by the State Board of Finance. (See funding table).

In addition, the 1979 Legislature appropriated $500,000 for advance planning/ study grants for CAC projects to be financed from the 1979 severance tax bond fund through the New Mexico State Highway Department. Of that appropriation, $235,260 was funded in 1979 and 1980 with the remaining $264,740 reverting to the Highway Department in 1981 as provided by the 1979 CAC amendments. Another $150,000 was allocated in 1981 from the General Fund for planning grants.


CAC DISTRICT MAP
SAN JUAN
RIO ARRIBA
TAOS
COLFAX
UNION
MCKINLEY
SANDOVAL
MORA
HARDING
SAN MIGUEL
SANTA FE
GUADALUPE
TORRANCE
CIBOLA
VALENCIA
SOCORRO
DE BACA
CHAVES
EDDY
LEA
LUNA
HIDALGO

FUNDING TABLE

Year	Construction Project Appropriation	Planning Study Appropriation	Number of Funded Projects	Amount of Reverted Funds
1977	$10,000,000	$ -0-	32	$ -0-
1978	1,500,000	-0-	8	-0-
1979	7,975,000	-	25	-0-
	-	500,000*	6	-0-
1980	5,000,000	-0-	19	-0-
	-	-	5	264,740**
1981	10,000,000	-	32	
	-	150,000	11	
Total	$34,475,000	$ 385,260 (Excludes reverted funds)	116 Const. 22 Plng.	$ 264,740

Total Funds Committed to Date for Projects and Planning Studies are:

$34,860,260.00

FUNDED PROJECTS IN AREAS IMPACTED BY THE OIL AND GAS INDUSTRY

Since the inception of the Community Assistance Program, those areas of the State, principally, the northwest and the southeast, which are impacted by the oil and gas industry have received Community Assistance grants for needed public facilities projects in accordance with CAC eligibility requirements and rules and regulations. A summary of projects funded in those political subdivisions impacted by the oil and gas industry by type of project follows:

1977 Funding Year

Water Projects -

Hobbs		$ 786,000.00
Carlsbad		439,740.00
Cuba		225,000.00
Aztec		550,000.00
Bloomfield		347,000.00
Farmington		1,366,785.00
Farmington		250,000.00
San Juan:	Lower Valley	196,300.00
San Juan:	Flora Vista	111,582.00
San Juan:	Lee Acres	170,300.00
San Juan:	Southside	170,300.00
San Juan:	West Hammond	128,830.00
San Juan:	Blanco	145,300.00
1977 Total		$4,887,137.00

1978 Funding Year

Water Projects -		
	Aztec	$ 216,000.00
	Lovington	200,000.00
	1978 Total	$ 416,000.00

1979 Funding Year

Water Projects -		
	Aztec	$ 450,000.00
	San Juan: Lee Acres	195,000.00
	Bloomfield	183,500.00
	Carlsbad	900,000.00
	Sub Total	$1,728,500.00
Sewer Projects -		
	Bloomfield	$ 70,000.00
	Farmington	241,800.00
	Sub Total	$ 311,800.00
Bridges Projects -		
	San Juan County	$ 660,000.00
	San Juan County	400,000.00
		$1,060,000.00
Streets Projects -		
	Bloomfield	$ 600,000.00
	Farmington	725,000.00
		$1,325,000.00

1981 Funding Year

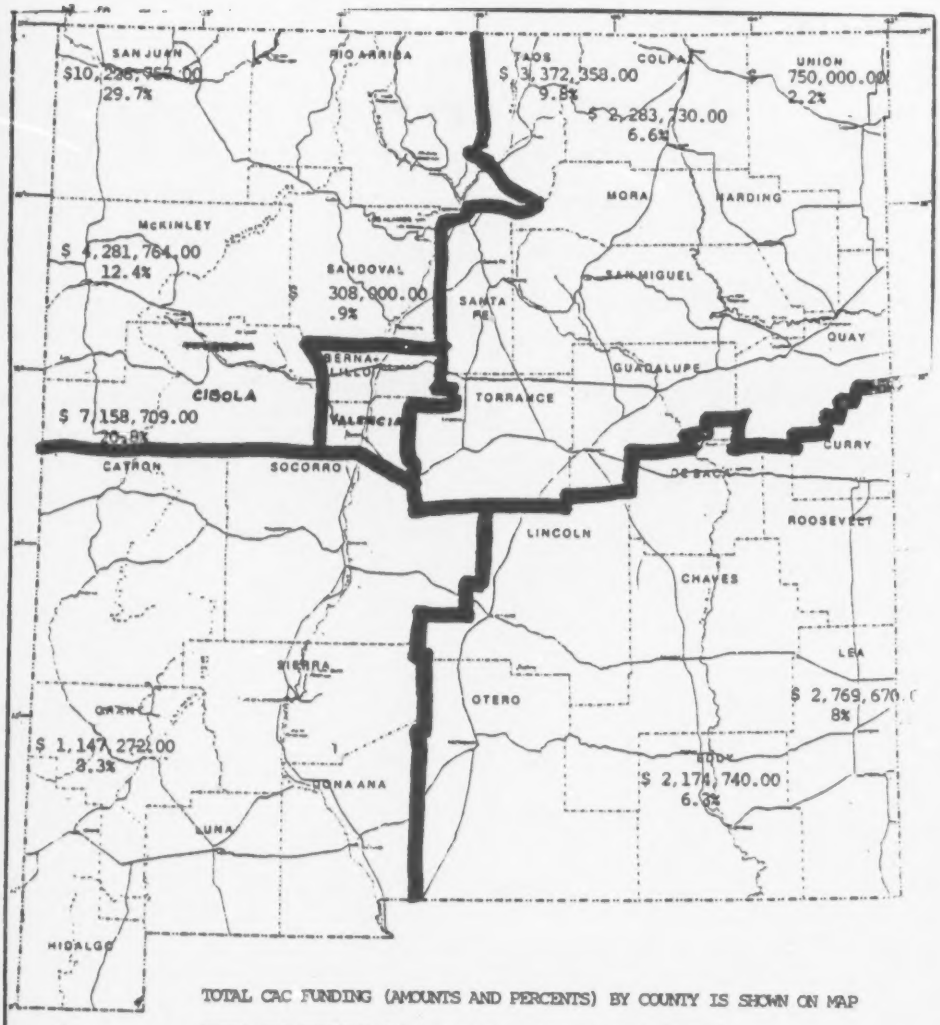
Water Projects -		
	San Juan: Upper La Plata	$ 90,000.00
	Cuba	83,000.00
	Eunice	154,000.00
	Lovington	400,000.00
	Aztec	254,600.00
	Loving	160,000.00
	Sub Total	$1,141,600.00
Sewer Projects -		
	Carlsbad	$ 380,000.00
	Hobbs	709,230.00
	Sub Total	$1,089,230.00
Streets Projects -		
	Farmington	$ 500,000.00
	Hobbs	520,000.00
	Sub Total	$1,020,440.00
Buildings Projects -		
	Bloomfield	$ 450,000.00
Planning Studies -		
	San Juan County	$ 12,000.00
	Aztec	9,000.00
		$ 21,000.00
	1981 Total	$3,722,270.00

1979 Funding Year (continued)

School Projects -		
	Farmington Schools	$ 251,460.00
Planning Studies -		
	Cuba	55,000.00
	1979 Total	$4,731,760.00

1980 Funding Year

Water Projects -		
	Aztec	$ 25,000.00
	Aztec	175,000.00
	San Juan: Lower Valley	235,000.00
	Carlsbad	93,000.00
	Sub Total	$ 528,000.00
Sewer Projects -		
	Carlsbad	$ 202,000.00
Buildings Projects -		
	San Juan County	$ 385,000.00
Streets Projects -		
	Farmington	$ 485,000.00
Planning Studies -		
	Bloomfield	$ 10,000.00
	Aztec	15,500.00
	Sub Total	$ 25,500.00
	1980 Total	$1,625,500.00



TOTAL CAC FUNDING (AMOUNTS AND PERCENTS) BY COUNTY IS SHOWN ON MAP

TOTAL CAC FUNDING (AMOUNTS AND PERCENTS) BY DISTRICT:

District 1 -	$ 21,977,230.00	- 63.8 %
District 2	1,147,272.00	- 3.3
District 4	4,944,410.00	- 14.3
District 5	6,406,088.00	- 18.6
TOTALS	$ 34,475,000.00	100.0

$10,000,000.00

EMPLOYMENT BY THE OIL AND GAS INDUSTRY

The following table provides an historical overview not only of employment by the oil and gas industry but also of average earnings of those employed. In addition, the severance taxes paid by the oil and gas industry is included and can be compared to Community Assistance total appropriation by year and to actual allocations for projects within those counties eligible by virtue of the oil and gas activity occurring therein.

Also provided for reference are two exhibits (Exhibit F) from the 1981 CAC Annual Status Report which shows CAC funding by district and by county.

EXHIBIT F

COMMUNITY ASSISTANCE COUNCIL

Funding by District and County

DISTRICT/COUNTY	1977 FUNDS	1978 FUNDS	1979 FUNDS	1980 FUNDS	1981 FUNDS
District One					
San Juan	$ 3,436,397.00	$ 416,000.00	$ 3,776,760.00	$ 1,305,000.00	$ 1,294,600.00
McKinely	2,255,660.00	75,500.00	50,000.00	959,004.00	941,600.00
Sandoval	225,000.00	-0-	-0-	-0-	83,000.00
Cibola (Valencia)	2,857,203.00	310,000.00	1,796,240.00	675,266.00	1,520,000.00
Subtotal	$ 8,774,260.00	$ 801,500.00	$ 5,623,000.00	$ 2,939,270.00	$ 3,839,200.00
District Two					
Grant	$ -0-	$ -0-	$ -0-	$ 317,000.00	$ 830,272.00
Subtotal				$ 317,000.00	$ 830,272.00
District Four					
Lea	$ 786,000.00	$ 200,000.00	$ -0-	$ -0-	$ 1,783,670.00
Eddy	439,740.00	-0-	900,000.00	295,000.00	540,000.00
Subtotal	$ 1,225,740.00	$ 200,000.00	$ 900,000.00	$ 295,000.00	$ 2,323,670.00
District Five					
Colfax	$ -0-	350,000.00	$ 20,000.00	$ 413,730.00	$ 1,500,000.00
Taos	-0-	148,500.00	1,432,000.00	1,035,000.00	756,858.00
Union	-0-	-0-	-0-	-0-	750,000.00
Subtotal	$ -0-	$ 498,500.00	$ 1,452,000.00	$ 1,448,730.00	$ 3,006,858.00
TOTALS	$10,000,000.00	$1,500,000.00	$ 7,975,000.00	$ 5,000,000.00	$10,000,000.00

HISTORICAL OVERVIEW OF CAC RELATED DATA

		Total State	Lea County	Eddy County	San Juan County	Chaves County	Roosevelt County
EMPLOYMENT (Annual Average)							
	1981	17,432	8,766	2,001	4,140	919	39
	1980	13,441	7,381	1,399	3,472	620	54
	1979	10,918	6,301	1,108	2,568	388	48
	1978	9,872	5,780	915	2,244	321	20
	1977	9,185	5,582	897	1,900	309	2
	1976	8,267	5,136	769	1,553	335	2
	1975	8,865	5,373	909	1,729	362	-
INCOME (Annual Average of Weekly Earnings)							
	1981	$ 467.49	455.35	442.92	477.96	470.64	304.59
	1980	$ 396.32	378.46	361.95	451.21	411.95	245.85
	1979	$ 344.16	330.12	319.26	386.26	380.97	211.58
	1978	$ 313.60	302.91	285.30	345.93	351.67	177.11
	1977	$ 278.94	273.93	254.35	300.99	329.36	95.82
	1976	$ 252.41	251.05	229.00	262.53	286.03	35.07
	1975	$ 231.33	232.52	204.34	239.59	273.37	-
SEVERANCE TAXES (Combined Oil & Gas)							
	1981						
	1980	$ 150.19 million					
	1979	$ 85.08 million					
	1978	$ 77.92 million					
	1977	$ 67.44 million					
	1976	$ 51.15 million					
	1975	-					
CAC APPROPRIATIONS							
	1981	$ 10 million ($150,000)*					
	1980	$ 5 million					
	1979	$ 7.975 million ($500,000)*					
	1978	$ 1.5 million					
	1977	$ 10 million					
	1976	-					
	1975	-					
CAC ALLOCATION (For Projects)							
	1981	$ 10 mil	$1,783,670	$540,000	$1,294,600		
	1980	$ 5 mil	-	295,000	1,305,000		
	1979	$ 7.975 mil	-	900,000	3,776,760		
	1978	$ 1.5 mil	200,000	-	416,800		
	1977	$ 10 mil	786,000	439,740	3,436,397		

* Planning Study Appropriations.

IDENTIFIABLE PROJECTED PUBLIC FACILITIES NEEDS

The Community Assistance Council staff in 1981 completed a study, "An Account of Resource Development in New Mexico, which was intended as a guide for the Community Assistance Council in its determination of community needs. Although, the priorities given at that time by communities then eligible for CAC funding may have sincechanged, the listing is a credible indication both of the extensive public needs of communities throughout New Mexico and of the funding needed to assist in the construction of these public works.

Included here is a copy of the page in the report which lists by priority the community needs as identified by communities in southeastern New Mexico.

Table II-8
SOUTHEAST NEW MEXICO COMMUNITY NEEDS

COMMUNITY	PROJECT NEEDS	COST ESTIMATE
Hobbs	1 - Fire Substation Construction	$ 665,000.00
Hobbs	2 - Grimes Street Rehabilitation	1,285,000.00
Hobbs	3 - Water Supply Construction	1,578,947.10
Hobbs	4 - Municipal Service Bldg. Safety Renovations	556,800.00
Hobbs	5 - Navajo Drive -	10,353,754.00
	Phase I - Flood Water Control	1,835,000.00
	Phase II - Construction	5,418,754.00
	Phase III - Construction	3,100,000.00
Hobbs	6 - Intersection Improvements	884,500.00
Hobbs	7 - Wastewater Flow Equalization & Separators	1,809,230.00
	Subtotal	17,133,231.10
Carlsbad	1 - Airport Sewer Interceptors & Boyd Drive Storm Sewer	450,000.00
Carlsbad	2 - Fire Station Bldg. & Equip.	250,000.00
Carlsbad	3 - Acquisition of Water Rights	1,000,000.00
	Subtotal	1,700,000.00
Loving	Water Transmission Line	173,000.00
Eddy County	26 mi. of NM 239 & County Rd. A012 north from Carlsbad to US 82	5,100,000.00
Eddy County	28.4 mi. of NM 31 east & north to US 62/180 to Jct. with NM 360	3,100,000.00
Eddy County	19.3 mi. of NM 360 north & west of NM 31 to US 82 east of Artesia	8,100,000.00
	Subtotal	16,300,000.00
Lovington	1 - Repair 11 wells in well field	330,000.00
Lovington	2 - Increase Water Tank Pressure	300,000.00
Lovington	3 - Straighten Bypass Death Curve	350,000.00
	Subtotal	980,000.00
	TOTAL	36,113,231.00

CAC Districts' Population Growth by County

District I	1980	1970	% Change
Sandoval	34,799	17,492	98.9
San Juan	80,833	52,517	53.9
Valencia	60,853	40,576	50.0
Cibola	30,109	20,076	50.0
McKinley	54,950	43,208	27.2
District II			
Grant	26,204	22,030	18.9
Sierra	8,454	7,189	17.6
District IV			
Chavez	51,103	43,335	17.9
Eddy	47,855	41,119	16.4
Lea	55,634	49,554	12.3
Roosevelt	15,695	16,479	- 4.8
District V			
Colfax	13,706	12,170	12.6
Taos	18,862	17,516	7.7
Union	4,725	4,925	-4.1

APPENDIX III

QUESTIONS AND ANSWERS FOR THE RECORD

TEXAS EASTERN
Transmission Corporation

August 18, 1982

The Honorable Don Fuqua
Chairman
Subcommittee on Energy Development and Applications
Committee on Science and Technology
House of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

Please find enclosed the answers of Transwestern Gas Supply Company and Transwestern Pipeline Company to the questions submitted by your Subcommittee for purposes of the hearing on natural gas production held on July 30, 1982, in Roswell, New Mexico, at which we were unable to testify. The attached is submitted in lieu of our appearance at the subject hearing, and it is hoped that this information will prove useful to the Subcommittee's review of this issue and may be added to the hearing record.

Please let me know if you desire further information or if you have any comments on the attached material.

Sincerely yours,

Michael E. Costello
Manager, Government Relations

MEC:Crd
Attachment

cc: w/attachments to all
Members of the Subcommittee on
Energy Development and Applications

RESPONSES TO SUBCOMMITTEE QUESTIONS

Q: What role has your company played in the development of tight gas sands production in southeastern New Mexico, in terms of transmission and production operations?

A: Transwestern Gas Supply Company* has been the operator for a group comprised of Hunt Oil, Dallas, Texas; Enstar Petroleum (formerly C&K Petroleum), Midland, Texas; Pacific Lighting Exploration Company, Los Angeles, California; and McKay Oil Corporation, Roswell, New Mexico, in the development of tight sands. As operator, the company is responsible for the following:

Land:

Purchasing leases, negotiating rights-of-way with surface owners and obtaining permits and drilling rights.

Exploration & Production:

Proposing locations and planning programs for drilling, supervising on-site activities, witnessing logging of wells, and recommending completion for production or abandonment for individual wells.

Transwestern Pipeline Company purchases, transports, and sells, tight sands gas production in interstate commerce for resale. Its principal customers are Pacific Lighting Service and Supply Company, Los Angeles, California, and Cities Service Company, Tulsa, Oklahoma.

Q: When did your operations in this area begin?

A: Transwestern Gas Supply Company, as operator for the group described above, began acquiring leases in April, 1981. Drilling operations began in July, 1981.

---

* Transwestern Gas Supply Company is a wholly-owned subsidiary of Transwestern Pipeline Company.

Transwestern Pipeline Company has operated an interstate natural gas pipeline system in the southeastern New Mexico area since October, 1960. Transwestern Pipeline Company began purchasing and transporting gas from tight gas sands production from this area on March 15, 1982.

Q: What part of your production in that area comes from traditional gas production technology, and what part would you characterize as coming from enhanced gas recovery technologies?

A: All of our production in Abo utilizes traditional production technology.

Q: How would you characterize the gas-bearing formations in southeastern New Mexico?

A: The Permian Abo formation is an extremely tight, low-permeability, low-porosity reservoir, with erratic sand depositional characteristics.

Q: Does your company maintain a staff of in-house geologists, or prefer to utilize service companies?

A: Transwestern Gas Supply Company employs a staff of three geologists in Midland, Texas and maintains a field production office in Roswell, New Mexico. In addition, further technical assistance is available from corporate headquarters in Houston.

Q: Have you ever participated with the U.S. Department of Energy in enhanced gas recovery research and development programs?

A: We have not directly participated in any U.S. Department of Energy (DOE) program. However, Company personnel have attended numerous seminars on enhanced gas recovery R & D and participated in advisory group efforts and public invitational discussions.

Q: Have you ever participated with any state agencies in programs of the same type?

A: No.

Q: Please comment on the effectiveness of these government programs, in terms of (1) advancing the state of the art, (2) technical quality, (3) ability to transmit the information generated by an experienced program to potential users, and (4) any other criteria you may feel should be addressed.

A: Although we have not directly participated in any government programs, we believe that these programs have advanced the state of the art of production of marginal and conventional gas resources, and we understand that the technical quality of the programs has been very good. We believe that the transmittal of information to potential users could be improved.

Q: What price are you now receiving for gas produced from tight gas formations in this area?

A: The applicable price prescribed by the FERC under section 107 of the Natural Gas Policy Act ($5.32/MMbtu in August).

Q: What experience have you had in your ability to market this gas?

A: Transwestern Gas Supply Company is selling production in the Abo area to Transwestern Pipeline Company. Some market impact has resulted from continuing price increases of numerous categories of gas under NGPA, as well as conservation effects, the effect of the economic recession on the industrial market, and fuel switching to alternate fuels. For these reasons, Transwestern Pipeline Company has experienced some impact on its marketing ability. This is evidenced by the two principal customers' (Cities Service Gas Company and Pacific Lighting) recent reduction of their takes from Transwestern Pipeline Company.

Q: Where are these markets?

A: The initial sale of Transwestern Gas Supply Company's gas is in Chavez County, New Mexico, at the wellhead to Transwestern Pipeline Company. Transwestern Pipeline Company transports this gas to its California and Oklahoma customers.

Q: Please comment on the procedures used by the state commissions and FERC in designating tignt gas sand formations, for the purpose of high cost gas designation.

A: The companies have not thus far been involved in the procedures of designation of tight gas sand formations.

Q: What plans do you presently have for continued development of gas production in this area?

A: Transwestern Gas Supply Company will continue its development program as long as there is a market for the gas at a price which provides a reasonable incentive for the production of the gas.

Q: What plans do you have for expanding transmission capacity?

A: Transwestern Pipeline Company sought FERC approval in 1981 and early 1982 for construction of the following projects:

(1) A $124 million joint venture with Northwest Pipeline Corporation to build 162 miles of pipeline to connect Transwestern's system to Northwest's system near Ignacio, Colorado. (Transwestern investment $62 million). The new pipeline, called the Continental Divide Project, would transport gas supplies acquired from Northwest Pipeline Corporation and could be operational in 1983. This project would provide the company access to Overthrust Area supplies.

(2) $16 million of gas compressor and related facilities along the company's Panhandle lateral line that would increase capacity of the Texas Panhandle lateral by approximately 100 MMcfd beginning in 1982.

(3) A $24 million project to add 36 miles of pipeline and a compressor to handle increased supplies from the Abo Gas Trend Area in New Mexico.